



Zhong Zhang

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Personal Statement

I am a Ph.D. candidate in the School of Aerospace Engineering at Tsinghua University, deeply interested in the confluence of Astrodynamics and artificial intelligence. My primary research revolves around trajectory optimization, optimal control of spacecraft, and the scheduling of autonomous space systems. It's the intersection of these domains—leveraging heuristic algorithms and machine learning techniques—that I find especially intriguing, evident in its applications to challenges such as space debris removal and asteroid exploration. Up to now, I have published many papers in top journals such as Journal of Guidance, Control, and Dynamics and IEEE Transactions on Aerospace and Electronic Systems. And I led a team to win the 11th edition of the Global Trajectory Optimization Competition (GTOC 11) in 2021.

Among the notable projects I've undertaken are:

- Optimal strategies for large-scale space mission design via heuristic algorithms.
- Data-driven methods for improved spacecraft trajectory optimization.
- Robust and fast neural policy for spacecraft guidance.

Education

Tsinghua University, China. Ph.D. Candidate

Supervisor: Prof. Junfeng Li

Co-Supervisor: Prof. Hexi Baoyin

August 2019 - Present

Lab of Astrodynamics, Major in Aerospace Engineering

- Honors:
Candidate for Tsinghua Top Grade Scholarship (a.k.a. Te Jiang), **Highest graduate student scholarship, top 10 out of 42000+ total graduate students per year**)
National Scholarship for Graduate Student, China(2022);
Future Scholar Scholarship, Tsinghua(2019)

Imperial College London, United Kingdom. Visiting Student

Supervisor: Dr. Davide Amato

Expected Jan. - Mar. 2024

Computational Astrodynamics research group, Department of Aeronautics

University of Illinois at Urbana-Champaign, United States. Visiting Student

Supervisor: Prof. Robyn Woollards

Sept. 2022 - Sept. 2023

Space Situational Awareness and Space Sustainability, Aerospace Engineering

Due to the COVID-19 and visa issue remote learning

Tsinghua University, China. Undergraduate Student

August 2015 - July 2019

Bachelor of Engineering, Major in Aerospace Engineering

- Honors:
Candidate for Tsinghua Top Grade Scholarship, **Highest undergraduate student scholarship, top 10 out of 16000+ total undergraduate students per year**)
Outstanding Undergraduate, Tsinghua(2019);
National Scholarship for Undergraduate Student, China(2017);

Publications

- Selected Papers

1. **Zhong Zhang**, Nan Zhang, Fanghua Jiang, Hexi Baoyin, and Junfeng Li. 2023. “Global Trajectory Optimization of Multi-Spacecraft Successive Rendezvous Using Multi-Tree Search”. *Journal of Guidance, Control, and Dynamics*.
<https://doi.org/10.2514/1.G007764>
2. **Zhong, Zhang**, Nan Zhang, Xiang Guo, Di Wu, Xuan Xie, Jinyuan Li, and Jia Yang. n.d. 2022. “GTOC 11: Results from Tsinghua University and Shanghai Institute of Satellite Engineering.” *Acta Astronautica*.
<https://doi.org/10.1016/j.actaastro.2022.06.028>
3. **Zhong, Zhang**, Nan Zhang, Yifei Jiao, Hexi Baoyin, and Junfeng Li. 2021. “Multi-Tree Search for Multi-Satellite Responsiveness Scheduling Considering Orbital Maneuvering.” *IEEE Transactions on Aerospace and Electronic Systems*.
<https://doi.org/10.1109/TAES.2021.3129723>
4. **Zhong, Zhang**, Zhibo E, Lixia Huang, Junfeng Li. 2021. “Semi-analytical algorithm for computing satellite-area target visibility.” *Journal of Tsinghua University(Science and Technology)*.
<https://doi.org/10.16511/j.cnki.qhdxxb.2021.26.020>
5. **Zhong Zhang**, Nan Zhang, Xiang Guo, Di Wu, n.d. 2023. “Sustainable Asteroid Mining: on the design of GTOC12 problem and summary of the results”. *Astrodynamics*. (Submitted)
6. **Zhong Zhang**, Xiang Guo, Di Wu, Hexi Baoyin, and Junfeng Li. 2023. “Global fuel optimum in multi-flyby trajectory optimization with a prescribed sequence”. *Journal of Guidance, Control, and Dynamics*. (Preparing to Submit)
7. Zhang Nan, **Zhong Zhang**, and Hexi Baoyin. 2023. “Multi-Trajectory Combination for Multiple Ground Target Observation by Maneuvering On-Orbit Satellites.” *IEEE Transactions on Aerospace and Electronic Systems*.
<https://doi.org/10.1109/TAES.2023.3303409>
8. Yang Jia, **Zhong Zhang**, and Fanghua Jia. 2022. “Low-Energy Transfer Design of Heliocentric Formation Using Lunar Swingby on the Example of LISA.” *Aerospace*.
<https://doi.org/10.3390/aerospace10010018>
9. Zhang Nan, Shiyu Chen, **Zhong Zhang**, and Hexi Baoyin. 2022. “A Two-Stage Dynamic-Assignment Optimization Method for Multispacecraft Debris Removal.” *Journal of Guidance, Control, and Dynamics*.
<https://doi.org/10.2514/1.G006602>
10. Zhang Nan, **Zhong Zhang**, and Hexi Baoyin. 2021. “Timeline Club: An Optimization Algorithm for Solving Multiple Debris Removal Missions of the Time-Dependent Traveling Salesman Problem Model.” *Astrodynamics*.
<https://doi.org/10.1007/s42064-021-0107-z>
11. Yin Chu, Di Wu, **Zhong Zhang**, Shengping Gong. 2023. “Potential of Sun-facing Diffractive Sail’s Sun-Earth Equilibria for Continuous Polar Observation”. *Journal of Guidance, Control, and Dynamics*. (Preparing to Submit)

- Selected Conferences

1. **Zhong Zhang**, Hexi Baoyin, Junfeng Li. 2023. “Trajectory design of international cooperative asteroid impact mission program.” 2nd National Planetary Defense Conference, Xinjiang, China.

2. **Zhong Zhang**, Xiang Guo, Di Wu, Junfeng Li, Fanghua Jiang. 2023. “Global fuel-optimal trajectory design for multi-flyby under given sequence.” 19th Annual National Deep Space Exploration Conference, Inner Mongolia, China. (Best Paper Award)
 3. **Zhong Zhang**.n.d. 2022. “GTOC 11: Results from Tsinghua University and Shanghai Institute of Satellite Engineering.” GTOC12 Workshop(Virtually), Hunan, China.
 4. **Zhong Zhang**, Zhibo E, Junfeng Li. 2020. “Satellite scheduling algorithm for large area targetwith complicated realistic constraints.” 2nd International Applied Mathematics, Modelling and Simulation Conference (AMMS 2020), Paris, France.
- Selected Software
1. **Zhong Zhang**. MultiTree Search Algorithm (C++) (for Multi-Spacecraft Successive Rendevous Mission).https://github.com/zhong-zh15/gtoc9_MTS-DP

Honors and Awards

- Candidate for Tsinghua Top Grade Scholarship(2023) (a.k.a. Te Jiang), **Highest graduate student scholarship, top 10 out of 42000+ total graduate students per year**)
- IHI Corporation First Class Scholarship(2023)
- Best Paper Award for 19th Annual National Deep Space Exploration Conference(2023)
- National Scholarship for Graduate Student, China(2022). Highest scholarship given by Chinese government
- Research Exploration Scholarship, Tsinghua(2022)
- **Winner and team leader of the 11th edition of Global Trajectory Optimization Competition.(2021)**
https://sophia.estec.esa.int/gtoc_portal/?page_id=782
- Future Scholar Scholarship, Tsinghua(2019)
- Outstanding Undergraduate, Tsinghua(2019)
- Candidate for Tsinghua Top Grade Scholarship(2018) (a.k.a. Te Jiang), **Highest undergraduate student scholarship, top 10 out of 16000+ total undergraduate students per year**)
- National Scholarship for Undergraduate Student, China(2017). Highest scholarship given by Chinese government
- National Encouragement Scholarship, China(2016, 2018)
- Academic Excellence Scholarship, Tsinghua(2017, 2018)

Research Experience

12th Global Trajectory Optimisation Competition (Organizer)

2023 (June. - July.)

- Responsible for designing the problem and the official website
<https://gtoc12.tsinghua.edu.cn/>
- A record number of more than 100 teams have registered
- Winner: NASA's Jet Propulsion Laboratory



GTOC 12

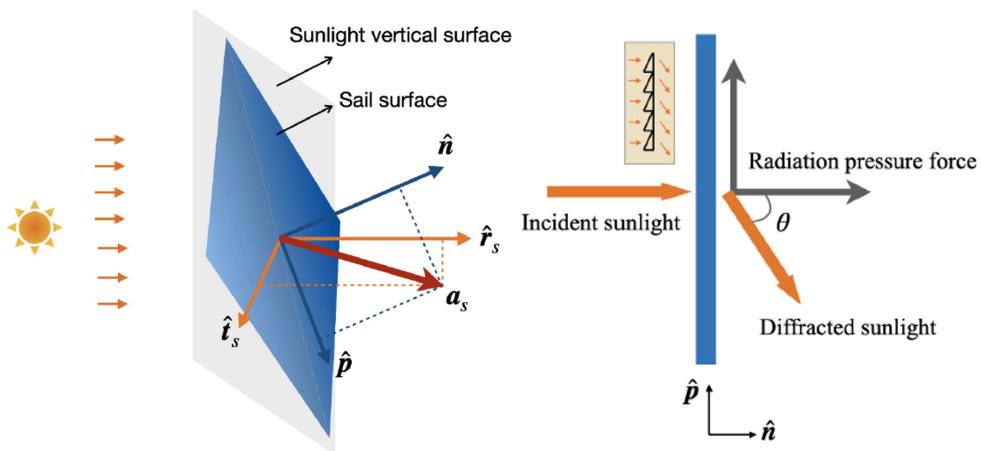
The 12th edition of the Global Trajectory Optimisation Competition, GTOC 12, is being hosted in 2023 by Tsinghua University and Shanghai Institute of Satellite Engineering. GTOC was started in 2005 by Dario Izzo, the leader of the Advanced Concepts Team of the European Space Agency. The competition was always a way to promote innovation and exchanges in spacecraft trajectory

Figure 1: GTOC12 website

Diffractive Solar Sail (Team member)

2023 Feb. - Now

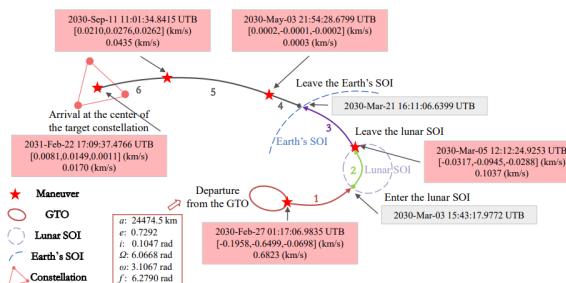
- Responsible for designing the optimal trajectory



Trajectory Design of Gravitational Wave Detector (Team member)

2021 November. - Now

- Responsible for designing the optimal transfer trajectory using the Lunar gravity assist



11th Global Trajectory Optimisation Competition
(First Place, team leader)

2021 (Oct. - Nov.)

- Led the team to obtain a final score of 8,443 points.
(Video demo at <https://www.bilibili.com/video/BV1yS4y197pP>)
- Proposed greedy-like algorithm for global asteroid assignment, achieving 95% efficiency and better than the second team by 5%.
- Other competitors, such as ESA's Advanced Concepts Team, University of Texas at Austin, etc.

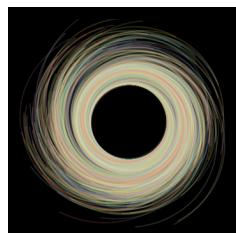


Figure 2: Our winning solution credited by ESA's Advanced Concepts Team

11th Chinese Trajectory Optimization Competition
(Second Place, core team member)

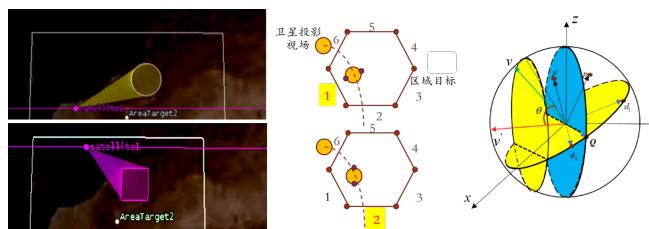
2020 (Sept. - Nov.)

- Completed two of the total three subtasks independently.
- A best post-competition result is found.

Constellation design and Scheduling basic tools
(CASC Project)

2019 Sept. - 2020 Dec.

- Realizing semi-analytic calculation of satellite visibility to regional targets
- Applied to distributed SAR satellite constellation



Deep reinforcement learning on air combat strategy
(AICC Internship)

2021 (Jun. - Aug.)

- Achieved 100% win rate vs. computer of dodging medium-range air-to-air missiles in DCS (an online air combat game on the Steam platform); over 90% win rate in 1 vs. 1 aerial gun combat.

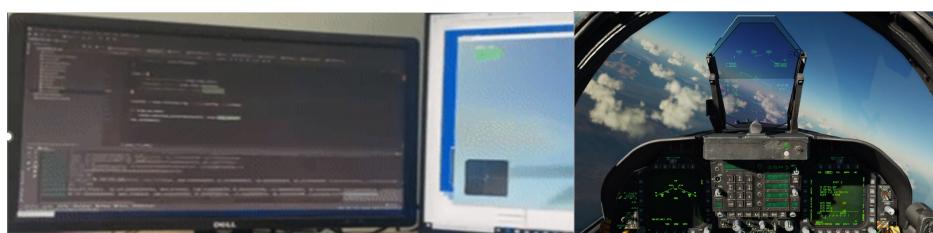


Figure 3: DCS World Scene

Ornithopter and tilt-rotor aircraft design
(Project, team member)

2018 Jun. - 2021 Aug.

- Responsible for kinematics analysis and controller design based on Pixhawk
- Achieve stable flying in flight test



Figure 4: Ornithopter and flight testing

Tilt-rotor aircraft design
(Project, team leader)

2018 Jun. - 2019 Jun.

- Responsible for overall design and controller design
- Achieve stable flying in flight test



Figure 5: Tiltrotor aircraft and flight testing