Zicen Xiong

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Interests: Dynamics and Control, Reinforcement Learning, Formation Flying

Education

- **Beihang University**
  M.S. Candidate in Spacecraft Dynamics and Control, GPA:3.89/4 (5%)   Sept. 2022 - Now

- **Beihang University**
  B.Eng. in Aerospace Engineering, GPA:3.8/4 (5%), **National Scholarship** (1%)   Sept. 2018 - Jun. 2022

Publications

Journals

- Zicen Xiong, Yue Wang, "Constant-Thrust Orbital Transfer about Binary Asteroids Using Bilinear Tangent Guidance", *IEEE Transactions on Aerospace and Electronic Systems, TAES*: online [paper]

Conferences

- Pengfei Lu, Shuhao Cui, Zicen Xiong, Yongjie Cheng, Yue Wang, "Trajectory Design of Reusable Transport Stations Between the Earth and Mars", *35th National Symposium on Space Exploration (in Chinese), NSSE*, 2023[slide]

- Zicen Xiong, Ruikang Zhang, Yue Wang, "Near-optimal Finite-thrust Orbital Control Near A Binary Asteroid System", *28th International Symposium on Space Flight Dynamics, ISSFD*, 2022 [pdf]

Researches

- **Satellite Formation Reconfiguration using Reinforcement Learning**   Nov. 2023 - Present
  Master's Thesis
  - **Problem:** The deterministic control methods have limited autonomy and difficulties in handling nonlinear constraints in satellite formation flying. How to achieve near-optimal/optimal multi-agent cooperation, reconfiguration and collision avoidance control in the absence/insufficient knowledge of prior dynamics?
  - **Method:** Multi-agent learning based MPC is being developed for satellite formation flying tracking problems.

- **Free-Flying Cubic Robot for Space Station**
  Conceptual Design for IAF-Space Universities CubeSat Challenge, SUCC   Jun. 2023 - Present
  - **Aim:** Self-propelled in-cabin assistant robot for astronauts in space stations with 6-DoF arm
  - **Method:** Double-gimbal fans enables the robot to have 6 DoF. SLAM mapping is used for in-cabin navigation. The PyTorch deep neural network is applied to monitoring astronauts's emotion.
  - The prototype is still under development and the conceptual design won 2nd Prize in China Grand Finale.[pdf][report]

- **Trajectory Design of Reusable Transport Stations Between the Earth and Mars**
  Solution to China Trajectory Optimization Competition, CTOC   Aug. 2022 - Oct. 2022
  - **Problem:** Martian migration mission requires the design of interplanetary transfers, escapes and captures of the Earth-Moon system, the optimization of massive missions and station sequences.
  - **Method:** The interplanetary transfer are obtained by developing a definitely matching gravity-assist optimization method and weak stability boundary (WSB). The low-energy escapes and captures in the Earth-Moon system is achieved via solving of a time-phase decoupling nonlinear programming (NLP) using particle swarm optimization (PSO) and dynamic programing (DP).[pdf]
  - Efficiently transporting over 4,000 passengers to Mars in 20 yrs with only 24 ships. Ranked 3rd Team in CTOC12 and orally reported at 35th NSSE.[report]

- **Constant-Thrust Orbital Transfer about Binary Asteroids Using Bilinear Tangent Guidance**
  Bachelor Thesis   Dec. 2021 - May 2023

- **Problem:** Current guidance algorithms in circular restricted 3-body problem(R3BP) are computationally expensive for autonomous orbital tracking near asteroids. This research tries to achieve efficient guidance for autonomous constant low-thrust guidance about binary asteroid systems.
  - **Method:** Spherical harmonic model is used for gravitational field modelling. A bilinear tangent constant-thrust guidance is derived by Pontryagin's maximum principle and manifold theory.
  - Acquire near-optimal and fuel-efficient control profiles and 200 times faster than IPOPT results. Talks on 2nd International Stardust Conference [abstract] and ISSFD28.[pdf][slide]

- **Design and Modelling of a CubeSat with Controllable Brake Sail**
  Course Project of Spacecraft System Design   Apr. 2021 - Jun. 2021
  - SolidWorks, ANSYS and STK practices on structural design, orbital control, modal, thermal and communication analysis. Score:95/100.[pdf][slide]

- **Multi-functional Electronic Scale with Quotation**
  Course Project of Electrical and Electronic Experiment 2   Sept. 2020 - Dec. 2020
  - Proteus design, prototype made with 74 series and NE555. Support functions: tare module, unit price-total price display. Score:95/100.[slide]

- **Heavy Load P3E Class Piston-Powered Aeromodelling**
  Member, Beihang Aeromodelling Team   Sept. 2018 - Dec. 2019
  - The aircraft for time-limited airdrop competition. Participated in manufacturing the composite parts for all race aircraft and fixed-point automatic airdrop mechanism based on Arduino PIX and GPS.
  - **Achievement:** Championship in 2019 China Aeromodelling Design Challenge.[video]

Competitions

- **2nd Prize, 2nd Space Universities CubeSat Challenge, SUCC**   Aug. 2023
  by International Astronautical Federation
- **1st Prize, 12th China's Trajectory Optimization Competition, CTOC**   Oct. 2022
  by Center for Space Utilization, Chinese Academy of Sciences   Ranked 3rd Team[rankinglist]
- **2nd Prize, 13th National Mechanics Competition for College Students**   May. 2021
  by Chinese Society of Theoretical and Applied Mechanics   Ranked 130th[rankinglist]
- **1st Prize in 12th National Mathematics Competition for College Students**   Dec. 2020
  by Chinese Society of Theoretical and Applied Mechanics
- **2nd Prize in China Undergraduate Mathematical Contest in Modeling 2020**   Oct. 2020
  by China Society for Industrial and Applied Mathematics
- **Champion in China Aeromodelling Design Challenge 2019**   Oct. 2019
  by Aero Sports Federation of China   Champion Team[rankinglist]

Honors and Awards

Items by Ministry of Education
- **National Scholarship, Top 1%** Student in the Academic Year [announcement][report]   2021

Items by Beihang University
- **Academic Excellence Scholarship for Graduates**   2022, 2023
- **Freshman Scholarship**   2022
- **Outstanding Graduate**   2022
- **Academic Excellence Scholarship for Undergraduates**   2019 - 2021

Skills

- **Language**: English(IELTS 8.0, R9L9W7.5S6), Chinese(Native)
- **Coding**: Python, MATLAB, C/C++, Git, LaTeX
- **Hard&Software**: Arduino, ROS, CAD (SolidWorks), STK, ANSYS, Multisim, Proteus, ADAMS
- **Photograph**: Aircrafts[homepage]/Railway/Astronomical/Underwater/Wildlife[video]
- **Misc.**: HAM(Amateur Radio)[**BI1RKD's QRZ**], Illustration[report], Rescue Diver, Weightlifting, Miniature Model Manufacturing