

## Personal Information



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### 1. Personal Statement

**Research Experience:** Extensive experience in **sensor tasking, target tracking, and information fusion** techniques. Conducted in-depth studies of various traditional and **artificial intelligence** algorithms, **filters** in information theory, and several information fusion theories.

**Research Interests:** Strong interest in **asteroid science, sensor tasking, reinforcement learning, multi-sensor information fusion, multi-target tracking, and outer probability measures.**

### 2. Education

**PhD of Aerospace Engineering (2026-present):** Department of Aerospace Science and Technology, Politecnico di Milano, Italy

- Advisor: Paolo Panicucci

**Master of Aerospace Engineering (2022-2025):** School of Aerospace Engineering, Beijing Institute of Technology, Beijing, China

- Dissertation Title: “A Study on Sensor Tasking Methods for Space-Based Situational Awareness Considering Epistemic Uncertainty”
- Advisor: Han Cai
- GPA: 3.76/4(Peking University GPA calculation method)
- Date of graduation: June 2025

**Bachelor of Science (2018-2022):** Guidance, Navigation, and Control Engineering, School of Aerospace Engineering, Beijing Institute of Technology, Beijing, China

- Dissertation Title: “Giant Low Orbit Constellation Mission Planning Study”
- Advisor: Han Cai
- GPA:3.6/4(Peking University GPA calculation method)

- Date of graduation: June 2022

### **3. Relevant Research Skills**

Proficient in: MATLAB, Python

Familiar with: C++, LaTeX, Windows, Linux, Word, Excel, PowerPoint

Language skills: IELTS Overall Score 7.0 (Reading 8.5, Listening 7.0, Speaking 6.0, Writing 6.0)

### **4. Publications**

#### **Journal Publications**

- [1]. **Chenbao Xue**, Han Cai\*, Steve Gehly, et al. Review of sensor tasking methods in Space Situational Awareness[J]. Progress in Aerospace Sciences, 2024.
- [2]. Han Cai, **Chenbao Xue**, Xiucong Sun\*, et al. Multi-Sensor Possibility PHD Filter for Space Situational Awareness[J]. Chinese Journal of Aeronautics, 2024.
- [3]. Jiaxin Hao, Han Cai\*, **Chenbao Xue**, et al. Possibilistic multi-sensor tasking for geosynchronous space object[J]. Aerospace Science and Technology, 2025,
- [4]. Han Cai\*, **Chenbao Xue**, Jeremie Houssineau, et al. Possibilistic space object tracking under epistemic uncertainty[J]. Advances in Space Research, 2023.
- [5]. Han Cai, **Chenbao Xue**\*, Xuxin Lu, et al. Space-Based Optical Active–Passive Sensor Tasking for Catalog Maintenance and Expansion[J]. Journal of Astronautics (Accepted), 2025.
- [6]. Jingrui Zhang, Yifan Cai, **Chenbao Xue**, et al. LEO mega constellations: review of development, impact, surveillance, and governance[J]. Space: Science & Technology, 2022.
- [7]. Han Cai, Yihang Jiang, **Chenbao Xue**, et al. Robust Multiple Space Object Tracking Using Possibility Generalized Labeled Multi-Bernoulli Filter[J]. Space: Science & Technology, 2025.
- [8]. Han Cai, **Chenbao Xue**, Jeremie Houssineau, et al. Robust Multi-Sensor Multi-Target Tracking Using Possibility Labeled Multi-Bernoulli Filter[J]. arXiv, 2024.

#### **Under Review**

- [1]. **Chenbao Xue**, Han Cai\*, Jiaxin Hao, Steve Gehly, Yang Yang. Priority based sensor tasking for space object surveillance involving maneuvers[J]. Journal of Guidance, Control, and Dynamics, 2025
- [2]. Han Cai, Lincheng Li\*, Yihang Jiang, Jeremie Houssineau, **Chenbao Xue**. Robust Multiple Space Object Tracking Using Possibility Generalized Labeled Multi-Bernoulli Filter[J]. Acta Astronautica, 2024

#### **Conference**

- [1]. **Chenbao Xue**, Han Cai, et al. Hierarchical Sensor Tasking for Catalog Maintenance Considering Target Maneuver. Accepted for the oral presentation of the 75th International Astronautical Congress (IAC) in Milan Italy, 2024
- [2]. Jeremie Houssineau, **Chenbao Xue**, et al. Decentralised multi-sensor target tracking with limited field of views via possibility theory. Accepted for the 27th International Conference on Information Fusion in Venice, Italy, 2024

### **5. Honors**

- [1]. **National Scholarship** for Master's Students (**Ranked 1<sup>st</sup> in the School of Aerospace Engineering**)
- [2]. Master's **top-class scholarship** for the 2022-2023, 2023-2024, 2024-2025 academic year.  
The highest academic scholarship for masters at Beijing Institute of Technology
- [3]. Bachelor's **first-grade scholarship** for the 2021-2022 academic year.  
The highest academic scholarship for undergraduate students at Beijing Institute of Technology
- [4]. **Exemplary Student** for the 2023-2024 academic year.
- [5]. **Excellent Graduate** of Beijing Institute of Technology.
- [6]. **Excellent Graduate** in Beijing.
- [7]. **Outstanding Master's Thesis** of Beijing Institute of Technology. (**Ranked 1<sup>st</sup> in the School of Aerospace Engineering**)
- [8]. 2025 **High-Level Master's Thesis**, Chinese Society of Astronautics (Only 15 master's theses selected nationwide)

## 6. Competition Award

- [1]. **Third prize in the 20th China Post-graduate Mathematical Contest in modeling.**
  - Establishing the **SEIR**(Susceptible, Exposed, Infectious, Recovered) differential equations to analyze the impact of large-scale movement of essential goods on the epidemic
  - Constructing the **K-means** clustering algorithm to determine the optimal distribution points for epidemic prevention supplies
  - The above process was implemented using **MATLAB** for code development.
- [2]. **Top-class prize in the 2021 "SFLEP·VocabGo Cup" National English Vocabulary Contest.**

## 7. Research Experience

- Multi-target tracking.
  - [1] Representing the states of multiple targets using Random Finite Sets (**RFS**).
  - [2] Employing **possibility functions** as a substitute for **probability density functions (pdfs)** to address scenarios of information insufficiency
  - [3] Conducting initial state determination based on Possibility Admissible Region (**PAR+**).
  - [4] Establishing the **possibility PHD filter** for the recursive prediction and update of targets.
  - [5] Establishing the Labeled Multi-Bernoulli (**LMB**) **filter** for the recursive prediction and update of targets.
  - [6] The process was implemented using **MATLAB** for code development.  
Keywords: MATLAB, RFS, Outer Probability Measure (OPM), Bayesian filter, PHD, LMB, PAR+
- Multi-sensor information fusion
  - [1] Realizing the prediction and update of Gaussian Max Mixture (**GMM**) models
  - [2] Establishing a **centralized** and **distributed** fusion framework for multi-sensor information fusion
  - [3] Utilizing Generalized Covariance Intersection (**GCI**) to fuse GMM information across multiple sensors
  - [4] The process was implemented using **MATLAB** for code development.  
Keywords: MATLAB, GMM, GCI, centralized fusion, distributed fusion
- Maneuvering targets sensing and tracking
  - [1] Constructing an **LMB** filter to track large-scale non-maneuvering targets.

- [2] Identifying **low-thrust** propulsion maneuvering targets using Normalized Innovations Squared (**NIS**).
  - [3] Estimating thrust parameters using Multiple Model Adaptive Estimation (**MMAE**)
  - [4] **Tasking sensors** based on the **hierarchical prioritization** of different targets.
  - [5] The process was implemented using MATLAB for code development.
- Keywords: MATLAB, NIS, MMAE, LMB, Low-Thrust Propulsion Maneuvers

- Multi-sensor tasking

- [1] Utilizing Differential Evolution (**DE**) to task multiple sensors for observing hundreds of targets.
- [2] Utilizing Actor-Critic (**AC**), Deep Q Network (**DQN**), and Deep Deterministic Policy Gradient (**DDPG**) methods for sensor tasking to track hundreds of targets.
- [3] DE was developed using MATLAB, whereas Reinforcement Learning (**RL**) methods were developed using Python.

Keywords: MATLAB, Python, DE, RL, AC, DQN, DDPG

## 8. Project Experience

- Tasking several ground-based optical sensors to track large-scale targets.

- [1] To address multi-sensor tasking problem based on the RL method, the existing sensor tasking **Python** code was enhanced from **DDPG** to Multi-Agent Deep Deterministic Policy Gradient (**MADDPG**)
- [2] Adjusting the network's **hyperparameters** to suit the user-specified sensor tasking scenario.
- [3] The process was implemented using Python for code development.

Keywords: Python, MADDPG

- Tasking several optical sensors to track large-scale targets, including maneuvering ones.

- [1] Utilizing the constructed **LMB** filter to track large-scale **non-maneuvering** targets.
- [2] Identifying **impulsively maneuvering** targets using **NIS**.
- [3] Estimating **impulsive maneuver** parameters using the **exhaustive search** method and tracking impulsive maneuvering targets.
- [4] The process was implemented using MATLAB for code development.

Keywords: MATLAB, LMB, Impulsive Maneuver