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Gao Yuman

EDUCATION BACKGROUND

- ◆ **University of California, Berkeley** **Nov 2024-Dec 2025**
 - **Visiting Scholar (Ph.D.)**, Hybrid Robotics Lab
 - Advisor: Prof. **Koushil Sreenath**, Prof. **Yi Wu** (Ex OpenAI researcher, Tsinghua University)
- ◆ **Zhejiang University** **Sep 2021-Jun 2026**
 - **Ph.D.** of Control Science and Engineering (CSE), FAST Lab
 - Advisor: Prof. **Fei Gao**
- ◆ **Zhejiang University** **Sep 2017-Jun 2021**
 - **CHUKOCHEN Honors College** (**Top 8%** of students in the whole school):
Advance Honor Class of Engineering Education (**Top 2%** of students in all engineering disciplines)
 - **BSc** of Control Science and Engineering, Robotics
 - **GPA: 3.96/4.00, Rank: 1/57**
 - Core modules: Optimization (4.0/96), C++ (4.0/95), Data Structures (4.0/95), Physics (4.0/96), Numerical Computation (4.0/95), Big Data Analysis (4.0/95)

RESEARCH EXPERIENCES

Published **2 IEEE T-RO** papers (1 first-author), **4 Science Robotics** papers. **5 first/co-first-author papers** in total; Focused on Motion Planning, Navigation, Autonomous Exploration, Reinforcement Learning, Multi-robot System:

- ◆ **Multi-Agent Cooperative and Competitive RL** **2025**
 - Conduct research on multi-agent reinforcement learning for multiple quadruped robots at UC Berkeley
 - Build a low-level motor skill library (walking, dribbling, kicking) using reinforcement learning
 - Develop hierarchical multi-agent RL methods for quadruped robot soccer, enabling long-horizon strategic reasoning via adversarial self-play
 - Completed real-world multi-robot experiments on a fully decentralized system
 - **Paper:** Zhi Su, **Yuman Gao (Corresponding and Co-first-author)**, et al. "Toward Real-World Cooperative and Competitive Soccer with Quadrupedal Robot Teams" Accepted by **CoRL** 2025
- ◆ **Autonomous Exploration with Bimodal Vehicles** **2025**
 - Develop a complete autonomous exploration system for terrestrial-aerial bimodal robots, enabling flexible decision-making (including modality switch) under time and energy constraints
 - Implement multi-layer terrain perception, bimodal Monte Carlo Tree Search (MCTS) planning, and trajectory generation under bimodal dynamics constraints
 - **Paper:** **Yuman Gao (First-author)**, Ruibin Zhang, et al. "Autonomous Exploration with Terrestrial-Aerial Bimodal Vehicles" Accepted by **RA-L** 2025
- ◆ **Gaussian-Splatting-based Active High-fidelity Reconstruction** **2024**
 - Active photorealism scene reconstruction with quadrotor utilizing 3D Gaussian Splatting technique
 - Online model-consistent completeness and quality evaluation to guide viewpoint selection
 - A planning framework for active reconstruction and safely navigation with 3DGS as scene representation
 - **Paper:** Rui Jin, **Yuman Gao (Co-first-author)**, et al. "Gs-planner: A gaussian-splatting-based planning framework for active high-fidelity reconstruction." **IROS**, 2024.

- ◆ **Adaptive Tracking and Perching Trajectory Optimization in Dynamic Scenarios** **2023**
 - High-efficiency full-onboard safe and perception-aware trajectory optimization framework
 - Deploy on Commercial quadrotors with fully onboard computation; achieve high-speed dynamic tracking and agile perching at 10 m/s and on 60° tilt surface
 - **IEEE Transactions on Robotics** popular articles highest **Rank No.5**, video with **40,000** views
 - **Paper: Yuman Gao (First-author)**, Jialin Ji, et al, Shaojie Shen and Fei Gao. "Adaptive Tracking and Perching for quadrotor in Dynamic Scenarios." **IEEE Transactions on Robotics (T-RO)**, 2024.
- ◆ **Multi-robot Coordinate Framework for Large-scale Communication-limited Exploration** **2022**
 - Collaborative exploration of unknown region by robots with communication range limitation
 - Efficient free space representation and querying via a particular polyhedron star convex
 - Effective collaborative exploration strategy based on designed meeting rule
 - **Paper: Yuman Gao (First-author)**, Yingjian Wang, et al, Fei Gao. "Meeting-merging-mission: A multi-robot coordinate framework for large-scale communication-limited exploration." **IROS**, 2022.
- ◆ **Swarm of Micro Flying Robots in the Wild** **2022**
 - **Science Robotic cover article**: Demonstrated a swarm of 10 fully autonomous, fully onboard-sensing, and fully onboard-computing palm-sized aerial robots safely navigating through dense bamboo forests; recognized by *Science Robotics* as the world's first autonomous aerial swarm system operating in unstructured natural environments
 - **Paper**: Xin Zhou, Xiangyong Wen, Zhepei Wang, **Yuman Gao**, Haojia Li, Qianhao Wang, Tiankai Yang et al. "Swarm of micro flying robots in the wild." **Science Robotics**, 2022.

Other papers:

- **Science Robotics 2025**: "Unlocking the aerobatic potential of quadcopters: Autonomous freestyle flight generation and execution". Mingyang Wang, Qianhao Wang, Ze Wang, **Yuman Gao** et al
- **Science Robotics 2025**: "Hierarchically depicting vehicle trajectory with stability in complex environments". Zhichao Han, Mengze Tian, et al, **Yuman Gao** et al
- **Science Robotics 2024**: "Microsaccade-inspired event camera for robotics". He, Botao, Ze Wang, Yuan Zhou, et al, **Yuman Gao** et al.

SOCIAL WORKS

- ◆ **Zhejiang University Student Association of Unmanned Systems** **President / Founder**
 - Led the team to participate in four world-class robotics competitions (UK, Canada, China) and hosted one international robotics event
 - Top-rated tech student organization on campus; awarded University Social Work Excellence

COMPETITION EXPERIENCES

Mathematical Contest in Modeling, First Prize (Notional level, China) (Top 0.7%)	2019
Mathematical Contest In Modeling (U.S.), Meritorious Winner (Top 13%)	2019
World Robotic Sailing Championships (UK), Third Place	2018

SELECTED AWARDS

Zhejiang University Outstanding Student	2023
Zhejiang University Scholarship-First Prize (Top 3%)	2021
Zhejiang Province Outstanding Graduates (Top 5%)	2021
CHUNHUI Scholarship (Top 2%)	2021
Zhejiang Province Scholarship (Top 3%)	2020

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高钰满 GaoYuman

教育经历 EDUCATION BACKGROUND

- ◆ 浙江大学，杭州 Sep 2021-Jun 2026
 - 博士，控制科学与工程学院，FAST Lab
 - 指导老师：高飞长聘副教授，许超教授
- ◆ 加州大学伯克利分校，美国 Nov 2024-Nov 2025
 - 访问学者（博士），机器人，Hybrid Robotics Lab
 - 指导老师：Prof. Koushil Sreenath, 清华大学叉院吴翼教授
- ◆ 浙江大学，杭州 Sep 2017-Jun 2021
 - 竺可桢荣誉学院（全校 Top 8%）：工程教育高级班 ACEE（工科 Top 2%）
 - 本科，控制科学与工程学院，自动化（控制），机器人方向
 - GPA: 3.96/4.00，排名：1/57
 - 核心课程：最优化与最优控制 (4.0/96)，面向对象编程 C++ (4.0/95)，数据结构 (4.0/95)，大学物理(4.0/96)，数值计算 (4.0/95)，大数据分析 (4.0/95)

科研经历 RESEARCH EXPERIENCES

共参与发表 2 篇 **IEEE Transactions on Robotics**（其中一作 1 篇），4 篇 **Science Robotics**（浙江大学第一单位历史共发表 5 篇），多篇期刊会议论文（共 5 篇第一作者/共同一作），侧重运动规划、自主导航、自动探索、强化学习、多机器人系统：

- ◆ 多智能体协作与对抗 Multi-Agent Cooperative and Competitive RL 2025
 - 加州大学伯克利访问期间，清华大学叉院吴翼教授指导，研究足式机器人多智能体强化学习
 - 利用强化学习，建立行走、带球、踢球的底层运动操作技能库
 - 采用多智能体强化学习方法，在多四足机器狗的足球对抗场景中，通过对抗性自我博弈实现策略推理，并在完全分布式的真实机器人系统上完成多机实物实验；
 - **Paper:** Zhi Su, Yuman Gao (通讯作者\共同一作), et al. "Toward Real-World Cooperative and Competitive Soccer with Quadrupedal Robot Teams" Accepted by CoRL 2025
- ◆ 空地双模态机器人自主探索 Autonomous Exploration with Bimodal Vehicles 2025
 - 开发使用于空地双模态机器人的完整自主探索系统，实现在时间、能量资源受限下的灵活决策
 - 实现多层地形感知、双模态蒙特卡洛树决策、双模态动力学约束下的路径搜索与轨迹规划；
 - **Paper:** Yuman Gao (第一作者), Ruibin Zhang, et al. "Autonomous Exploration with Terrestrial-Aerial Bimodal Vehicles" Accepted by RA-L 2025
- ◆ 基于高斯溅射的高精度重建 Gaussian-Splatting-based active high-fidelity reconstruction 2024
 - 利用三维高斯溅射技术，使用四旋翼机器人平台，进行主动的高保真场景重建
 - 在线进行完整性和质量评估，实时进行主动重建规划，直接在三维高斯表征的环境中安全导航
 - **Paper:** Rui Jin, Yuman Gao (共同一作), et al. "Gs-planner: A gaussian-splatting-based planning framework for active high-fidelity reconstruction." IROS, 2024.

◆ 动态场景自适应跟随与飞落轨迹规划

Adaptive tracking and perching trajectory optimization in dynamic scenarios

2023

- 提出一种高效安全的感知增强四旋翼轨迹规划框架，实现感知-规划闭环
- 部署于 DJI Mavic 3 上，全板载运行，实现 10 m/s 动态场景下高速跟随飞落，60° 倾斜飞落
- 机器人顶刊 **IEEE Transactions on Robotics** 高关注度文章排名第 5，视频获得近 4 万次播放。
- **Paper:** Yuman Gao (第一作者), Jialin Ji, Qianhao Wang, Rui Jin, Yi Lin, Zhimeng Shang et al, Shaojie Shen, Chao Xu, and Fei Gao. "Adaptive Tracking and Perching for quadrotor in Dynamic Scenarios." **IEEE Transactions on Robotics (T-RO)**, 2024.

◆ 通信受限条件下多机器人协作探索框架

Multi-robot coordinate framework for large-scale communication-limited exploration

2022

- 提出一套多机器人在通信距离和带宽受限条件下协作探索未知环境的系统级框架
- 提出高效的基于星形特殊多面体的空间表征和查询方法
- 设计基于集会机制的协作策略，在通信受限条件下完成多无人车和多无人机系统的协作探索建图
- **Paper:** Yuman Gao (第一作者), Yingjian Wang, et al, Fei Gao. "Meeting-merging-mission: A multi-robot coordinate framework for large-scale communication-limited exploration." **IROS**, 2022.

◆ 全自主微型飞行机器人集群

Swarm of micro flying robots in the wild

2022

- **Science Robotics 封面文章:** 10 架全自主、全本体感知、全机载算力微型飞行机器人集群安全飞跃密集竹林；Science Robotics 评价为国际首个非结构化场景下的自主飞行集群系统
- 新华社、人民网、光明日报、泰晤士报、Science、The Verge、浙江大学、中国科学院等大量报道，视频播放 > 200 万次，样机被国家博物馆收藏
- **Paper:** Xin Zhou, Xiangyong Wen, Zhepei Wang, Yuman Gao, Haojia Li, Qianhao Wang, Tiankai Yang et al. "Swarm of micro flying robots in the wild." **Science Robotics**, 2022.

◆ 空中追踪感知增强轨迹规划

Visibility-aware trajectory optimization with application to aerial tracking

2021

- 提出三种科学衡量可视性的平滑可微指标，并依此实现基于 B-Spline 的高效轨迹优化
- 在障碍物环境下，完成四旋翼空对空稳定追踪的实物实验
- **Paper:** Qianhao Wang, Yuman Gao, Jialin Ji, Chao Xu, and Fei Gao. "Visibility-aware trajectory optimization with application to aerial tracking." **IROS**, 2021.

其余部分文章:

- **Science Robotics 2025:** 四旋翼无人机全自主特技飞行 Mingyang Wang, Qianhao Wang, Ze Wang, Yuman Gao et al "Unlocking the aerobatic potential of quadcopters: Autonomous freestyle flight generation and execution".
- **Science Robotics 2025:** 层级式轨迹描绘 Zhichao Han, Mengze Tian, et al, Yuman Gao et al "Hierarchically depicting vehicle trajectory with stability in complex environments".
- **Science Robotics 2024:** 微眼动启发的机器人事件相机 He, Botao, Ze Wang, Yuan Zhou, et al, Yuman Gao et al. "Microsaccade-inspired event camera for robotics".
- **RSS 2025:** 语言指令下人形机器人端到端全身控制 Yiyang Shao, Xiaoyu Huang, Bike Zhang, Qiayuan Liao, Yuman Gao et al. "LangWBC: Language-directed Humanoid Whole-Body Control via End-to-end Learning".

项目经历 PROJECT EXPERIENCES

◆ DJI 大疆创新 车载无人机

May 2022-Mar 2023

- DJI 规划控制部门**实习**，调研-开发-部署-测试 **全链路负责人**
- 部署于 DJI Mavic 3，实现从全尺寸城市越野车起飞、跟拍、移动降落、倾斜飞落入后备箱等功能
- 相关预研成果已孵化为“**比亚迪灵鸢智能车载无人机系统**”，2025 年 3 月召开发布会
- **DJI 国际专利第一作者**

◆ 大规模异构机器人集群系统

2023-2024

- **技术总负责人**，**15 个体异构机器人集群系统**（视觉四旋翼、雷达四旋翼、共轴双旋翼、雷达阿克曼底盘车）在包含多种光照条件、障碍密集、有狭窄通道、有灰尘的多层建筑物内进行集群任务；
- 完成实物实验：障碍环境中集群弹性编队、协同未知环境探索、协同跟随、GPS 拒止下集群定位、无外部通信下自组网通信中继、1 控 15-人机交互

◆ 福特中国 多无人机跟拍系统

2024

- 合作**项目顾问**，实现多无人机多视角动态跟随拍摄特技车辆

社会工作 SOCIAL WORK

◆ 浙江大学学生无人系统技术创新协会

会长 / 协会创始人

- 任会长期间，领队参加 **4 次世界级机器人比赛**（英国、加拿大、中国），承办 1 次世界级赛事
- 设置从硬件设计到上层算法开发系列课程，参加比赛涵盖水上、陆地、空中各类机器人
- 任会长期间，协会为校级评分最高科技类社团，获校级社会工作标兵

竞赛获奖 COMPETITION EXPERIENCES

全国大学生数学建模竞赛，一等奖(国家级) (Top 0.7%)	2019
国际空中机器人大赛 IARC（亚太赛区），最佳识别奖	2019
ICRA RoboMaster 人工智能挑战赛（加拿大），第二名	2019
美国大学生数学建模竞赛，M 奖(一等奖)	2019
世界无人帆船竞标赛 WRSC（英国），小型组第三名	2018

荣誉获奖 SELECTED AWARDS

浙江大学优秀学生	2023
浙江大学一等奖学金 (Top 3%)	2021
浙江省优秀毕业生 (Top 5%)	2021
春晖奖学金 (浙江大学控制学院学生最高荣誉 Top 2%)	2021
浙江省政府奖学金 (Top 3%)	2020
华为菁英奖学金 (Top 1%)	2019

合作者 COLLABORATOR

- | | |
|--|--|
| · Zhongyu Li, UCB (RL on Legged Robot) | · Jiaze Cai, MIT (RL on Flapping Wing) |
| · Ruiqi Zhang, UCB (Aerial Robotics) | · Zhou Xin, HKUST (Swarm of Robot) |
| · Chao Yu, Tsinghua (Multi-agent RL) | · Yunfei Li, Tsinghua (RL) |