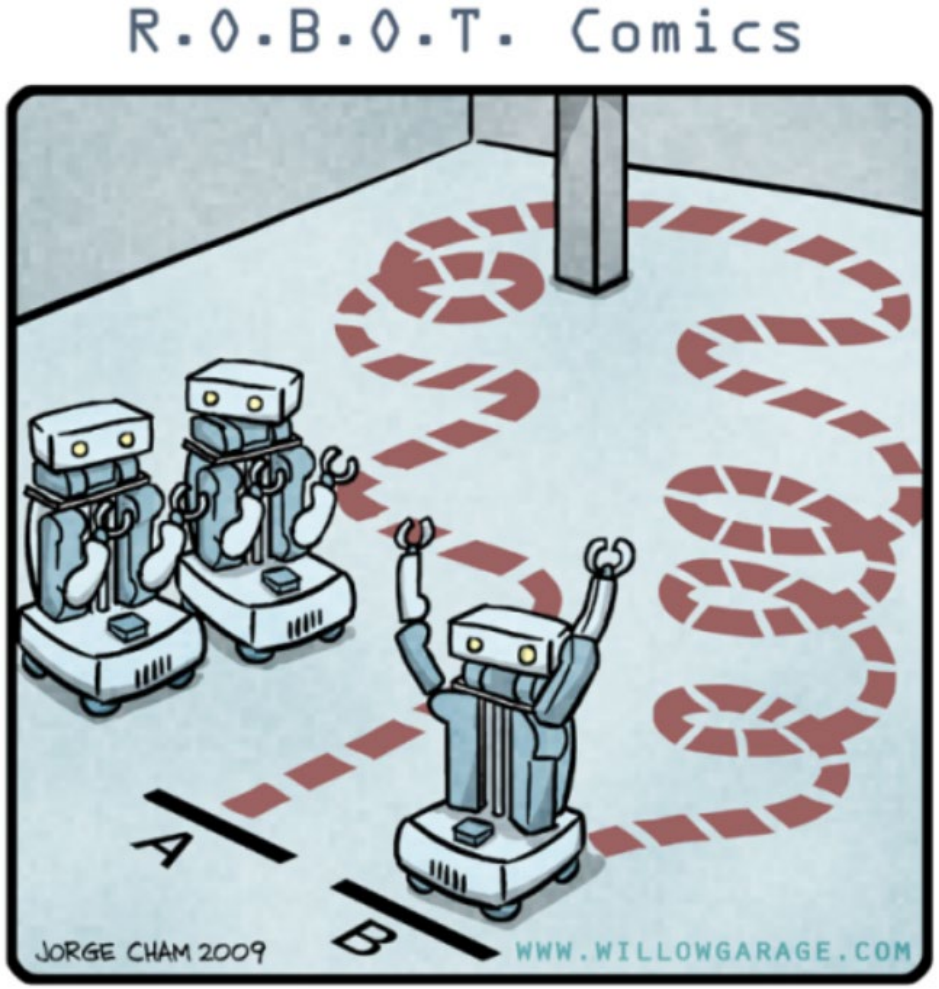
Tinspiratio & Tornado

FIRST Robotics Competition

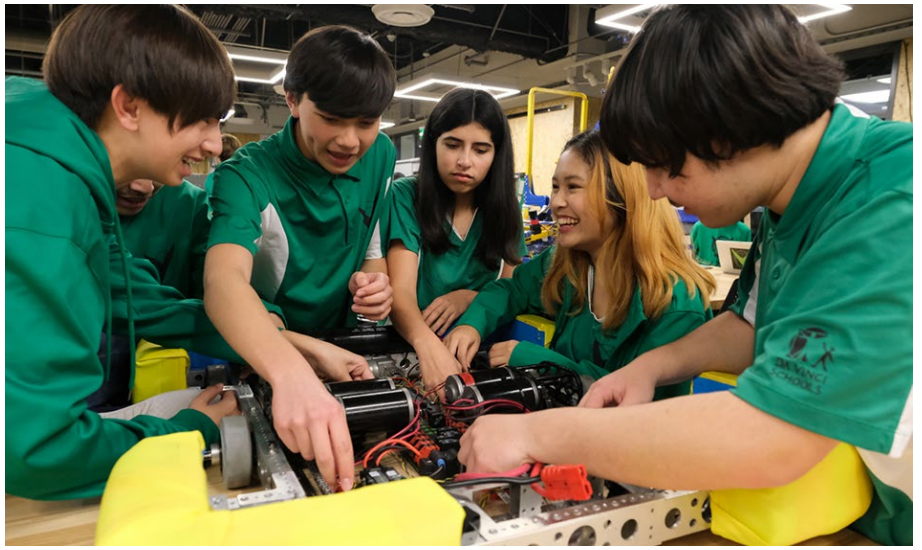
Jiajing Xie, Jiaheng Chang

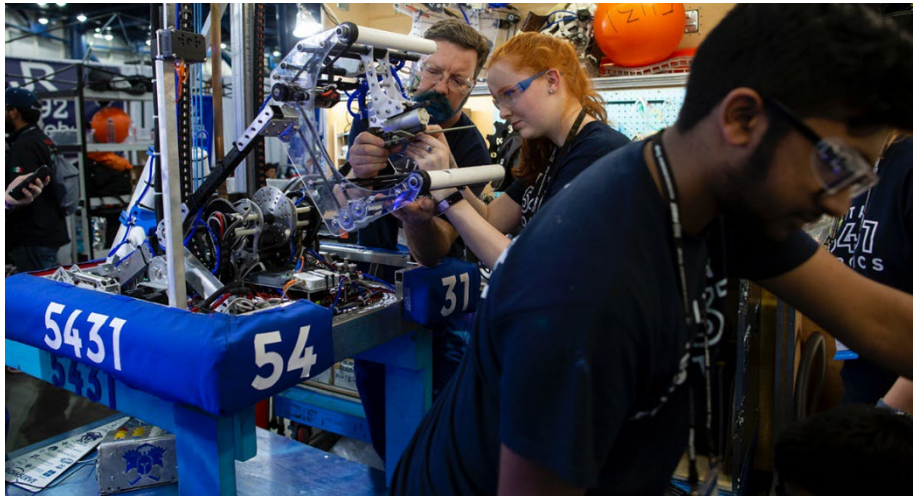


比赛简介

FRC全称FIRST Robotics Competition由美国发明家迪恩·卡门先生于1989年创建，至今已有30年历史，FRC机器人竞赛的文化基于两个核心价值观：**“优雅的专业精神”Gracious Professionalism**和**“竞争合作精神”Coopertition**。

仅2018赛季，FRC共吸引了来自近30个国家和地区超过9万名学生组成的3650支队伍报名参赛。**First的最终目标是激发学生们成为未来的科学与技术领袖。**



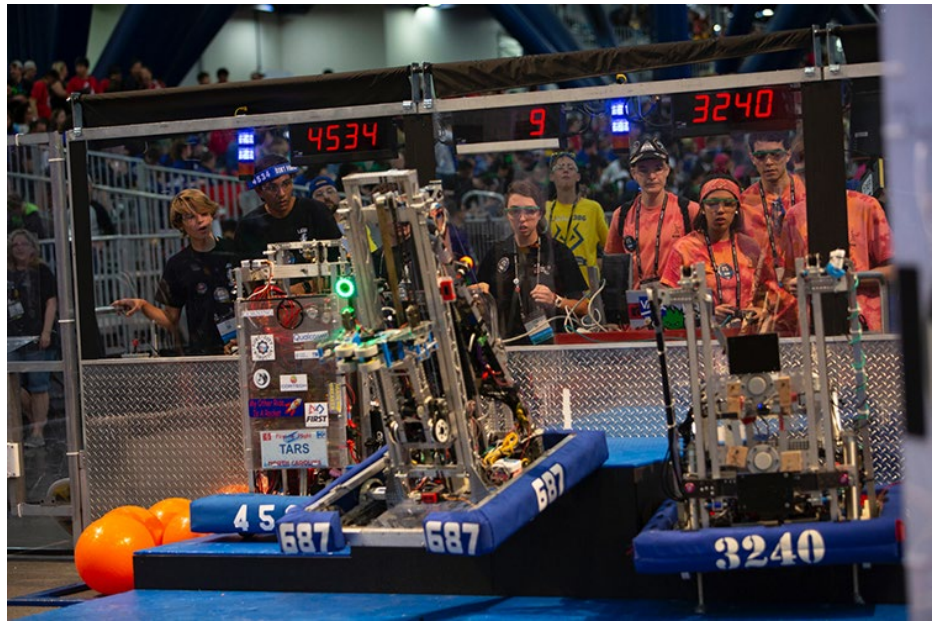


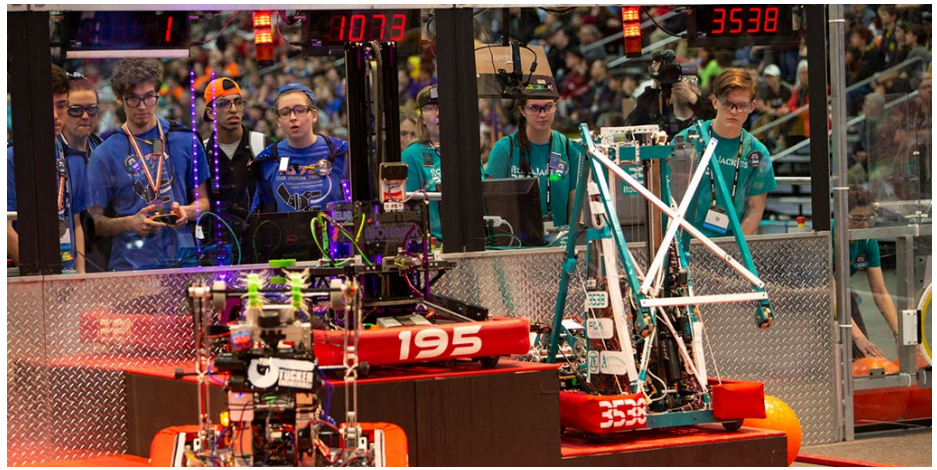
Courtesy: FIRST Robotics Competition

比赛简介

参加FRC需要学生在每年赛季公布主题后的约8周极限时间内，与团队**协作完成**一台具备复杂功能的**工业级机器人**。

学生需自主完成策略分析、机械设计、加工装配、程序编写、电路调试、宣传推广和资金筹措等一系列工作，全面锻炼工程实践、项目管理、跨学科协作和抗压能力，最终带着团队智慧的结晶踏上竞技舞台。





Courtesy: FIRST Robotics Competition

队伍历史

2016年11月，济南外国语学校组建了济南市第一支FRC机器人比赛队伍，命名为**Tinspiratio**，申请编号6399。明年，也就是2026年将是我们队伍成立的**第十年**。截至目前，我们仍然是**济南唯一一支**FRC队伍。

Tinspiratio由拉丁文“inspiratio”(灵感)与英文字母T合成。T代表着**Technology**(科技), **Team**(团队), **Technology Center**(技术中心), 还有锤子。

队伍历史

2017: 新秀最高分奖 | 最佳新秀奖

2021: 钱江 RCC **全国四强**

2023: 企业家精神奖

2024: 工程启发奖 | **全场唯一4RP满分**

2025: 联盟队长 | 大赛二等奖

2026: 未来可期

团队精神

Technology（科技）是我们参与FRC的基石。我们注重技术的自我提升与普及，每赛季都全力以赴，追求高效优质，**持续学习、突破自我**，展现6399的技术实力。

Team（团队）代表协作精神。团队合作保障效率，**交流学习**提升素养。6399是一个小家庭，FRC是大家庭，我们与对手互相尊重、共同成长。

Technology Center（技术中心）秉持平台化理念，推广科技、提供展示与锻炼的机会，让更多人**拓宽视野、实现自我**。明年我们将**重返正赛**，利用过往经验，再创佳绩。

学生团队

济南外国语学校6399战队始终秉持"学生主导、导师辅助"的理念，在FRC竞赛中完全由学生自主设计、制作和操作机器人，导师仅提供必要的技术指导和资源支持，真正实现学生全程主导的机器人研发与竞赛体验。

导师团队

谢佳静 大二

St Catherine's College
University of Oxford

辛然 大三

Fizwilliam College
University of Cambridge

张子睿 大二

香港科技大学郑家纯机器人研究院研究助理

学生团队：机械与程序

机械组负责机器人的整体结构设计与实现，包括使用 **SolidWorks / Onshape 进行三维建模**、金属材料加工、传动系统搭建以及**整机装配调试**，确保机器人在高强度比赛中保持稳定的机械性能。

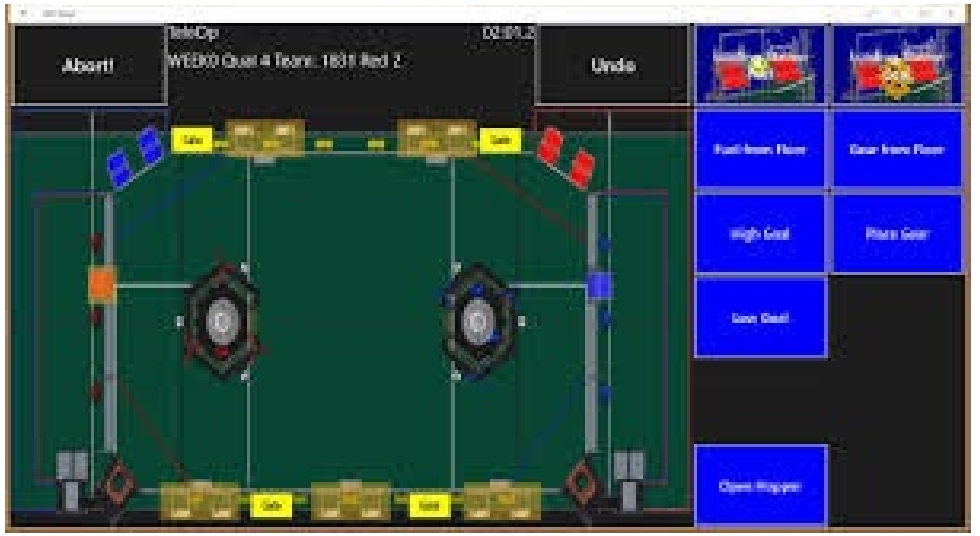
程序组专注于机器人**智能控制系统的开发**，运用Java/C++基于WPILib框架编写控制程序，集成视觉识别、传感器反馈和运动规划算法，实现机器人在自动与手动模式下的精准操控。

Courtesy: FRC Team 1690

学生团队：宣运与策略

宣传运营组承担团队品牌建设与资源保障工作，负责社交媒体运营、**赞助洽谈**、**资金管理**、宣传物料制作等，确保团队获得持续关注与资源支持，提升团队影响力。

策略组在比赛中通过实时数据采集与分析，评估对手实力与比赛态势，制定最优战术方案，为场上操作手提供**关键决策支持**，最大化团队得分能力。



Courtesy: FRC Team 254, FRC Scout

为什么加入？技能与经历

掌握硬核的工程技术

亲手实践工业级的机械设计、编程、电路与项目管理，远超课本理论。

培养顶尖的软实力

在高压极限中，锤炼解决复杂问题、团队协作与沟通领导的核心能力。

体验独一无二的旅程

收获与全球精英同台竞技的视野、深厚的团队情谊与挑战自我的成就感。

为什么加入？升学与发展

打造极具竞争力的申请背景

FRC经历是申请全球顶尖名校理工、商科、人文等专业的“金字招牌”。

获得丰富而立体的文书素材

从“解决问题”到“领导力”，你的每一个故事都真实、具体且充满说服力。

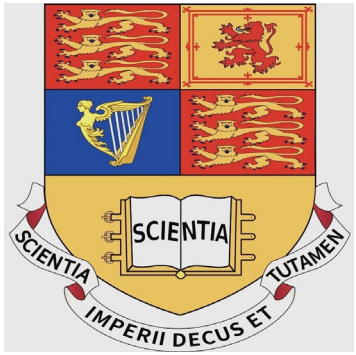
收获高含金量的推荐信

指导老师能从技术、协作、创新等多维度，为你写出深刻有力的推荐内容。

Courtesy: Stanford, MIT

为什么加入？升学与发展

历届录取成果



教学与课程

2026赛季，为了更好的让大家学习并掌握FRC中需要运用的知识，我们设计了“锤子的用途”系列课程，并申请通过了**济外特色课程**，努力推进FRC合法化进程。

Course Objectives:
At the completion of this course, students will be able to:

1. Explain the principles and requirements of the FIRST Robotics Competition (FRC) and apply engineering teamwork and project management practices within a student robotics team.
2. Design and prototype mechanical subsystems (e.g., drivetrains, elevators, intakes) using CAD tools, considering structural integrity, motion, and manufacturability.
3. Select appropriate materials and manufacturing methods (e.g., 3D printing, CNC, hand tools) based on functional and mechanical requirements.
4. Assemble and wire FRC electrical systems, including power distribution, motor controllers, sensors, and communication networks (e.g., CAN Bus), following safety and competition standards.
5. Demonstrate practical skills in soldering, circuit debugging, and integration of electronic components into a cohesive control system.
6. Program robot behaviors in Java using the WPILib command-based framework, including motor control, sensor feedback, and PID control for autonomous and teleoperated operation.
7. Integrate mechanical, electrical, and software subsystems into a fully functional robot through collaborative, project-based implementation and iterative testing.

教学与课程 Java编程基础

Module 4: Programming with Java

Session 1: Java Intro & Setup
Overview of Java language, JDK installation, IDE configuration, first Java program

Session 2: Java Syntax & Data Types
Variables and constants, primitive data types, type conversion, operators

Session 3: Conditionals & Flow Control
If-else statements, switch-case statements, ternary operator

Session 4: Loops & Arrays
For loops, while loops, do-while loops, array definition and usage

Session 5: Methods & Functions
Method definition and invocation, parameter passing, return values, method overloading

Session 6: OOP: Classes & Objects
Classes and objects, constructors, this keyword, encapsulation concepts

Session 7: OOP: Inheritance & Polymorphism
Extends keyword, method overriding, super keyword, polymorphism implementation

Session 8: OOP: Interfaces & Abstract Classes
Abstract class definition, interface implementation, multiple interface inheritance

Session 9: Exception Handling
Try-catch-finally, exception types, custom exceptions

教学与课程 电气控制系统

Module 3: Electrical and Control System (ECS)

Session 1: Basic Electrical Knowledge

Talking about basic physic knowledge in Electrical and Electronic area.

Session 2: Control System Hardware Component Overview And FRC Robot Wiring

Provide a brief overview of the hardware components that make up the FRC Control System;

Session 3: Basic Soldering Skills

Introduction to soldering tools and techniques, focusing on safe operation and creating reliable connections.

Session 4: Common Communication Protocols & CAN Bus & Sensors

PWM, CAN, I^2C, SPI, etc.), explain CAN Bus configuration, and explore typical sensors used in FRC.

Session 5: Debugging Skills & Integration with Software

Learn systematic debugging methods, identify common electrical issues, and understand how the electrical system integrates with robot software.

Session 6: More Practice With Soldering and ECS

Practical exercises to reinforce soldering, wiring (try to wire neat and beautiful), and full ECS setup, simulating real competition scenarios.

教学与课程 机械设计与制造

Module 2: Mechanical Design and Fabrication

Session 1: Chassis Fundamentals
Chassis structure, working principles, and an introduction to Tank (Differential) drive systems.

Session 2: Advanced Drivetrains
Principles and design considerations for Swerve drive, Omni drive, and Mecanum drive systems.

Session 3: Transmission Systems I
Introduction to gearboxes, focusing on single and dual reduction ratios for power transmission.

Session 4: Transmission Systems II
Detailed look at shifting mechanisms, including Ball shifters and Dog shifters

Session 5: Specialized Mechanisms I
Design of Climbers and Elevators, focusing on their structure, limitations, and

Session 6: Specialized Mechanisms II
Turret system design and its integration with a Swerve drive, plus various sh siderations.

Session 7: Specialized Mechanisms III
Design and prototyping of Intake and Gripper mechanisms, covering various tions.

Session 8: Prototyping & System Integration
Prototyping techniques and integrating subsystems based on available space and modular design principles.

Session 9: Electronics & CAD Management
Electronics layout, wiring diagrams, and CAD practices like version control and collaboration.

Session 10: Material Selection
Comparing properties and use cases for Aluminum, Steel, Carbon Fiber, 3D printing materials, Wood, PC, and PMMA.

Session 11: CAD & Manufacturing Prep
From 3D CAD to 2D dimensioning for manufacturing, including designing wiring holes and hollowed structures.

Session 12: Manufacturing Techniques
Introduction to key techniques: CNC machining, Lathe operations, 3D printing, Drilling, and Tapping.

教学与课程 FRC高级编程

Module 5: Advanced FRC Programming

Session 1: FRC Environment Setup
WPILib installation, VS Code configuration, creating first FRC project

Session 2: FRC Program Structure & Motors
Robot.java framework, motor object creation, basic motor movement control

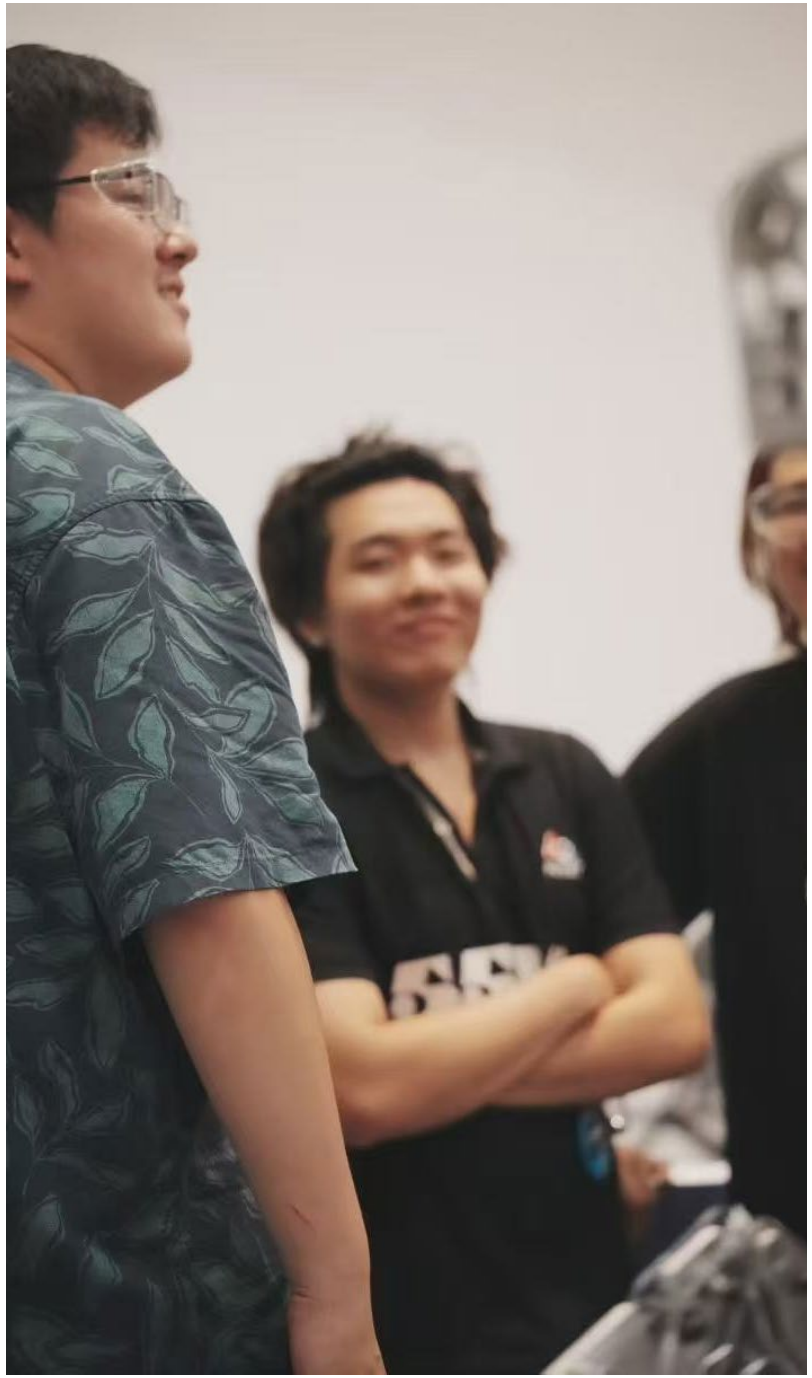
Session 3: Sensor Application
Digital sensors, analog sensors, encoder reading and data processing

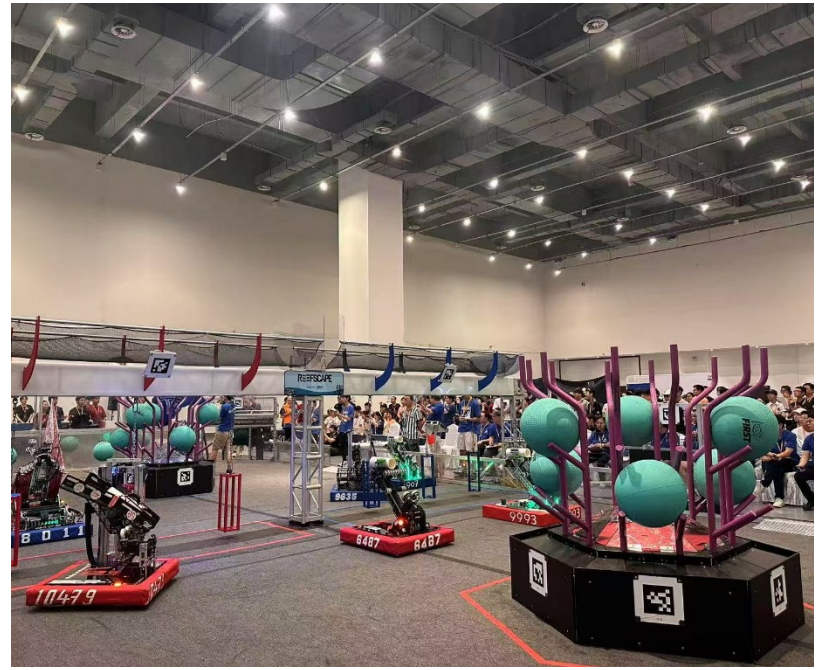
Session 4: PID Control
PID algorithm introduction, velocity PID control, position PID control

Session 5: Command-Based Programming I
Command pattern introduction, Subsystem creation, basic Command writing

Session 6: Command-Based Programming II
Command composition, parallel command groups, sequential command groups, triggered commands

Session 7: Simulation & Debugging
Simulation environment setup, Shuffleboard usage, AdvantageScope log analysis



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Q&A