



Future Intelligent Network System Laboratory

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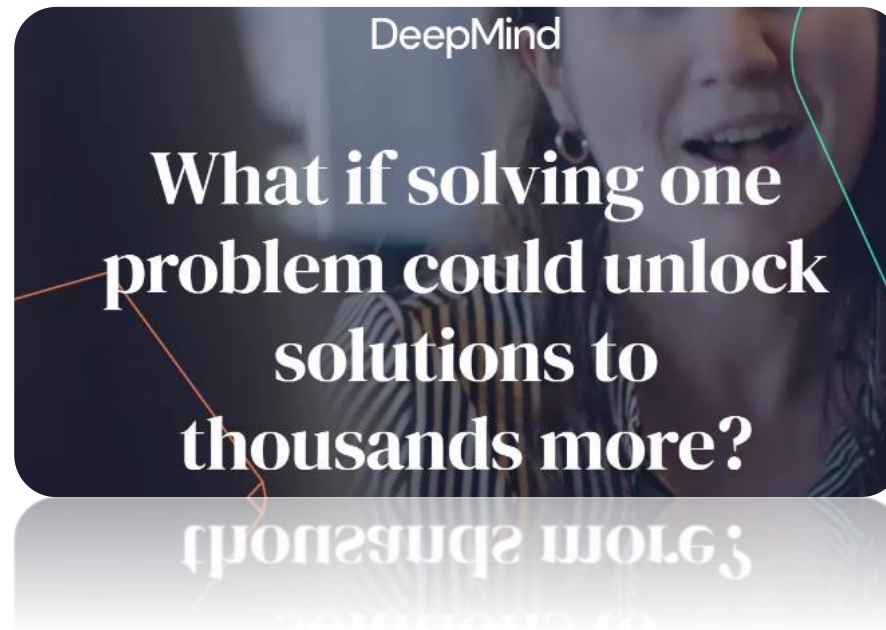
Homepage: <https://iwin-fins.com/>



Team Concept

- From small questions to essence of things
- Seize every spark of splendid ideas in daily life

Confident
Competitive
Cooperative



Work, work hard
Play, play well

Embrace research and make your devotion worthy!

博士生



黎侯杉



焦青



罗潇雨



丁续达

本科生



李鸿博
[助研]



蔡一凡
[UPenn]



王汉
[Oxford]



毛祥宇
[清华]



王亚蓉
[清华]



郑文喆
[北航]



杨大力



刘欣玮



张坤芳



郭春志

硕士生



孙明靖



马孟洲



蒋浩



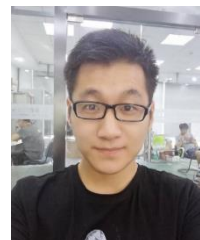
韩万斌



何志宇



李嘉伦



刘聪
[毕业]



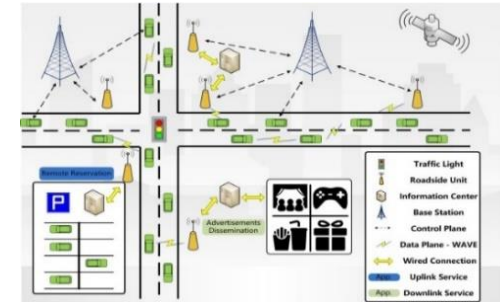
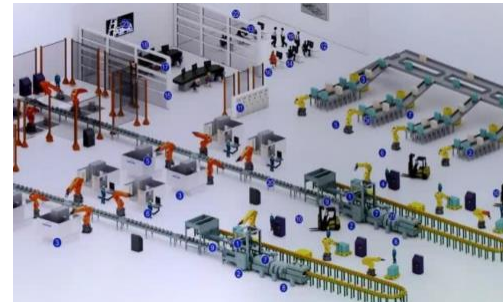
廖文静
[毕业]



缪洋
[毕业]

Research Interests

Network systems

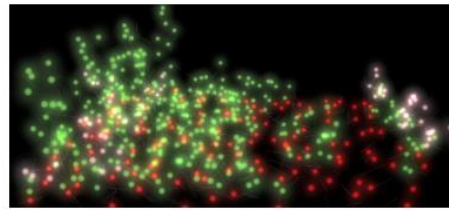


We focus on developing distributed, secure and intelligent systems for mobile robots, machine learning, control and optimization



Intelligent Robot Control Systems

- Advanced robot structure design and control
- Robots cooperative attack and defense
- Robot distributed operation software and systems



Secure Data-driven Cooperation



Coordinated Charging Systems

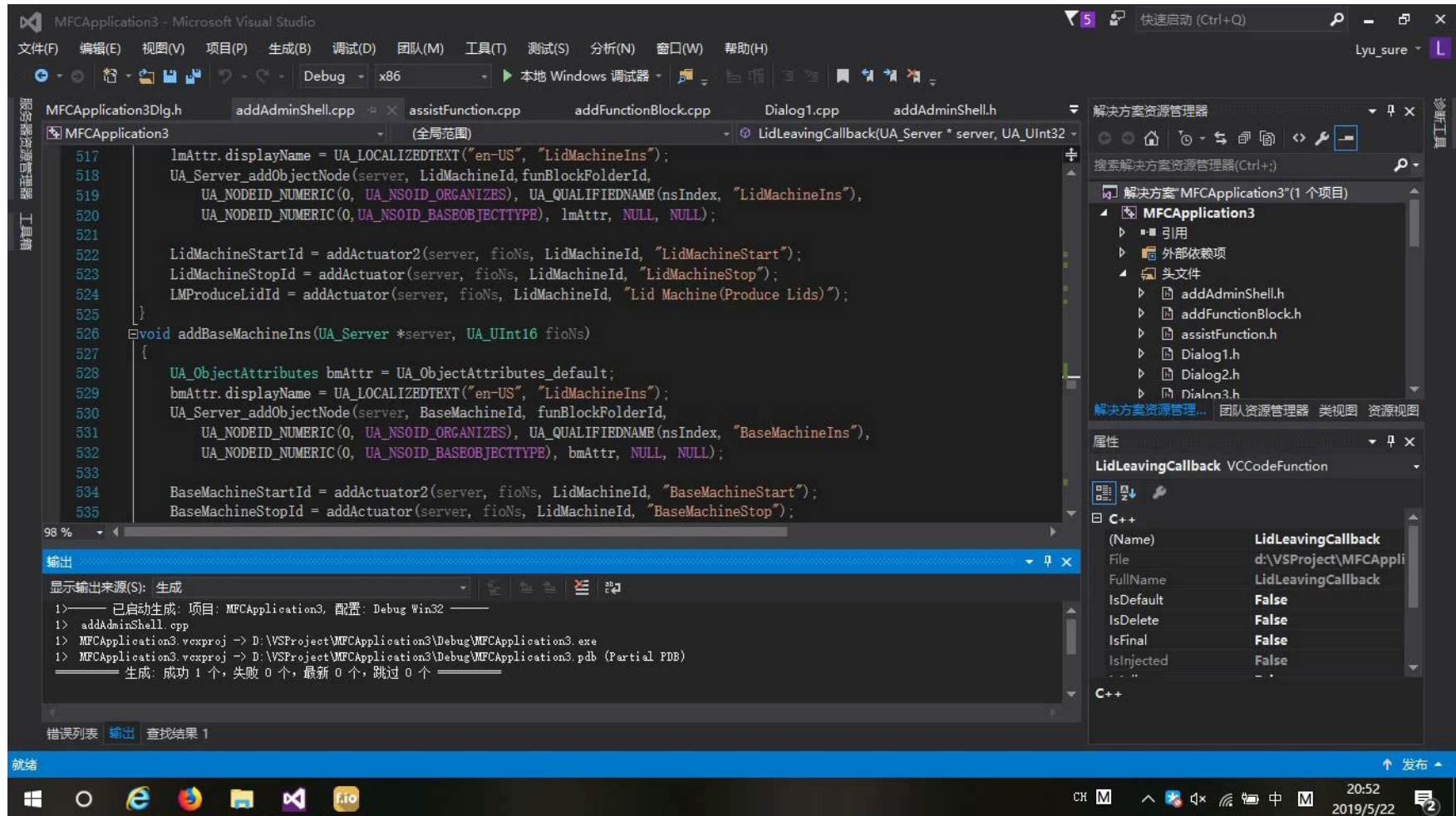
- Independable information based secure control
- Analysis and modeling for data privacy preservation
- Data-driven model inference and optimization



Multi-Agent Learning Systems

Network + Cooperation: Distributed, Secure, Intelligent

Integrated Information Model



Why Network and Cooperation



Networking + Cooperation

Distributed Learning, Control and Optimization

$$1 + 1 > 2 \text{ and } N+N \gg 2N$$

Multi-robot Systems, Multi-agent Systems, Sensor Networks, Vehicular networks



Multi-Robot System Group (Current)



Xuda Ding, **PhD**



Yushan Li, **PhD**



Qing Jiao, **PhD**



Jialun Li, **MS**



Hao Jiang, **MS**



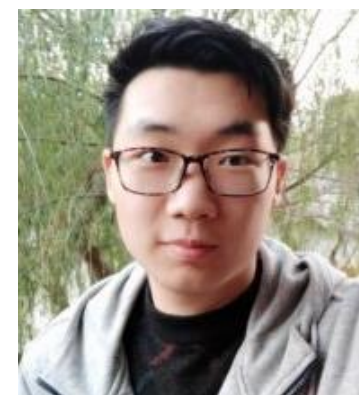
Han Wang, **UG**



Hongbo Li, **UG**



Xinwei Liu, **UG**



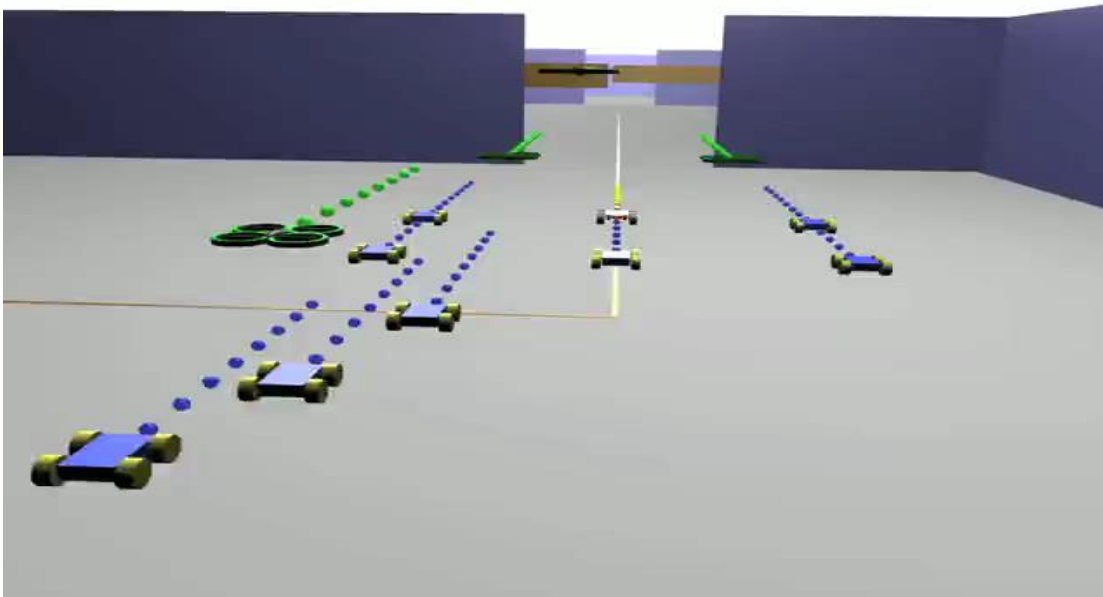
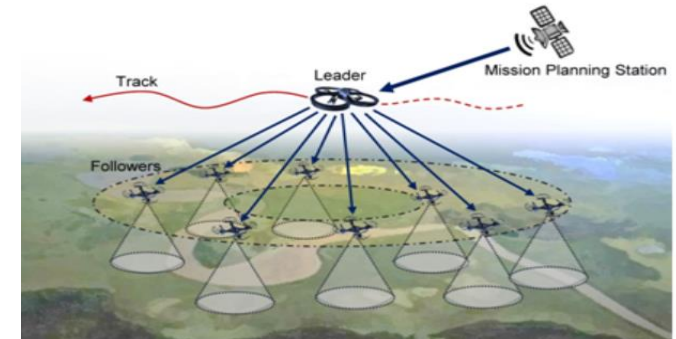
Dali Yang, **UG**

UG: Former undergraduate student, working as research assistant currently

Multi-robot Systems

A system consisting of multiple robots, where the robots coordinate with each other to achieve well defined goals

- The ability of single robot is limited
- Cooperate to perform complicated tasks
- Strong ability of acquiring and processing information



https://www.youtube.com/results?search_query=Navigation%2C+localization+and+stabilization+of+formations+of+unmanned+aerial+and+ground+vehicles.



G.-Z. Yang, et al., The grand challenges of science robotics," Science Robotics. 3(14), (2018).



An Introduction of Multi-robot Platform



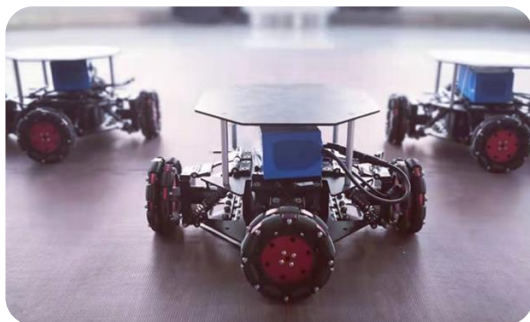
Jianping He
Center for Intelligent Wireless Networking and Cooperative Control
Shanghai Jiao Tong University

□ Our Design



V1 Mini化全向

高度：100mm
半径：75mm
位移控制精度：±1cm
最大速度：40cm/s
续航时间：6h
适合群集控制



V2 高承重越野

高度：180mm
半径：175mm
位移精度控制：±1cm
最大速度：147cm/s
无线通讯距离：100m载
重：7kg



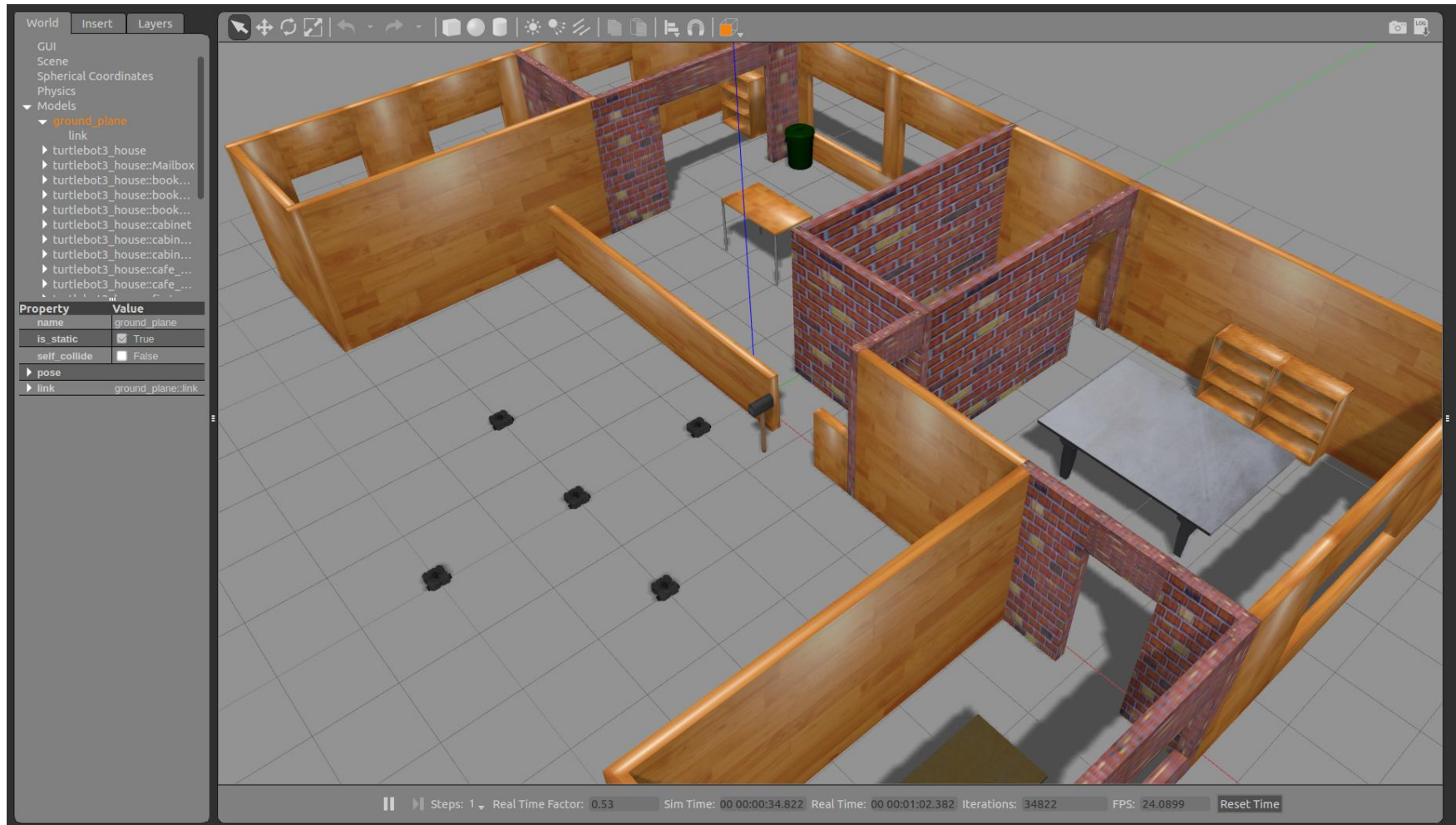
V3 抗外损强化

自身控制闭环
核心独立封装
机械性能强悍
车身载重强化
四轮独立悬挂系统
扩展口灵活适配

模块化设计 - 维护性高 模块编程易上手
全向/差速双模式控制 - 适用于多种场景

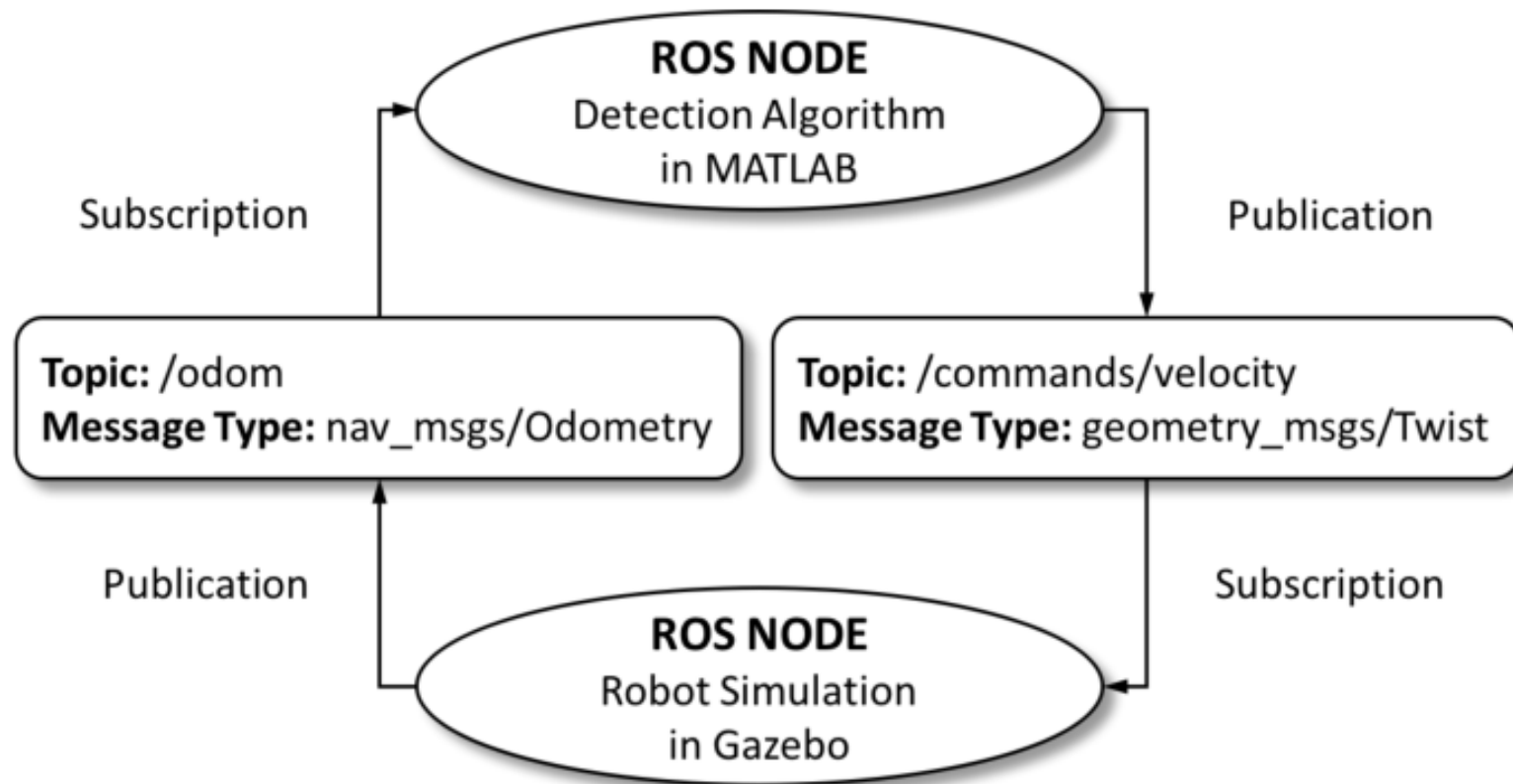
■ Gazebo仿真

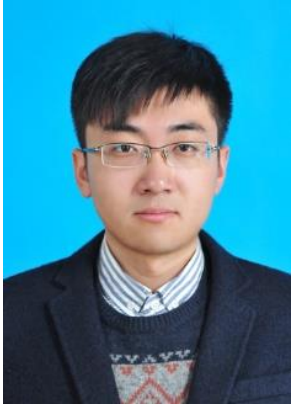
■ 非常贴近实际环境



■ ROS仿真架构

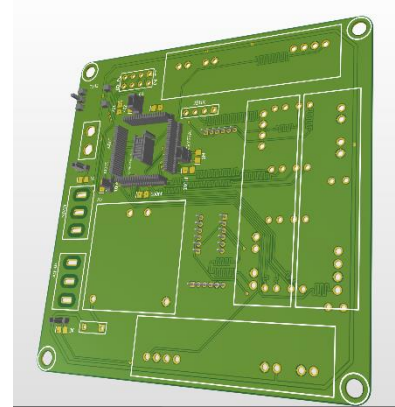
- Topic与Node
- Publication与Subscription





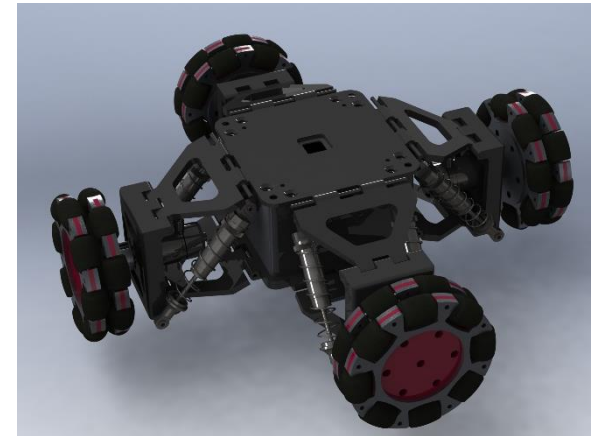
Xuda Ding (丁续达) *Ph.D Candidate, F19*

- **National scholarship** (国家奖学金, 2018)
- Outstanding MS student in NCEPU
- **National excellent MS thesis**
- Published 3 papers on famous conferences
- **Occupying 9 patents**



Research works

- Y Zhai, **X Ding***, X Jin, et al. “Adaptive LSSVM based iterative prediction method for NOx concentration prediction in coal-fired power plant considering system delay”, ASC 2020.
- J Hao, Y Li, **X Ding**, et al. “Obstacle Avoidance Algorithm Based on Human Experience Knowledge”, IEEE VTC 2020.
- J Hao, **X Ding**, J he, et al. “Information Value on Private State Inference in Network Systems”, IFAC 2020.



Multi-Robot Attack and Defense



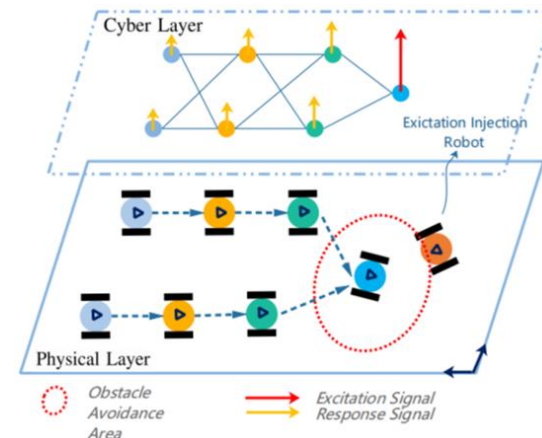
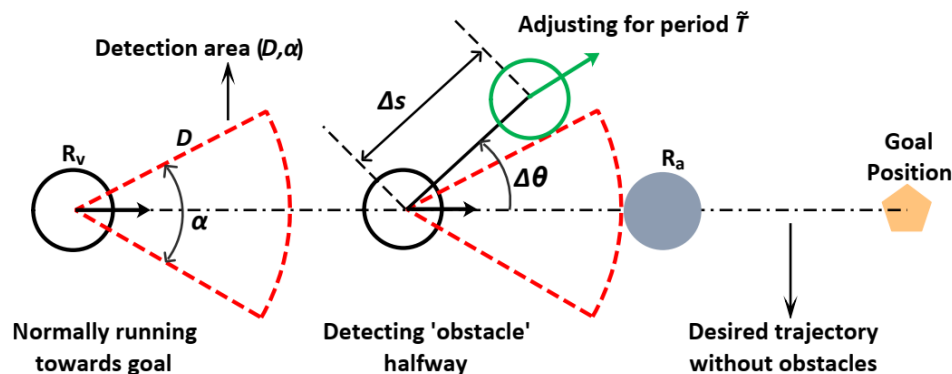
Yushan Li (黎侯杉)

Ph.D Candidate, F18

- Leader of Robot Group
- **Rank 1st** student in HUST, department of automation
- **National Scholarship** (国家奖学金), 2019
- Published 2 papers on well-known conferences
- Visit student at University of Newcastle, Australia, 2019.9-2019.11

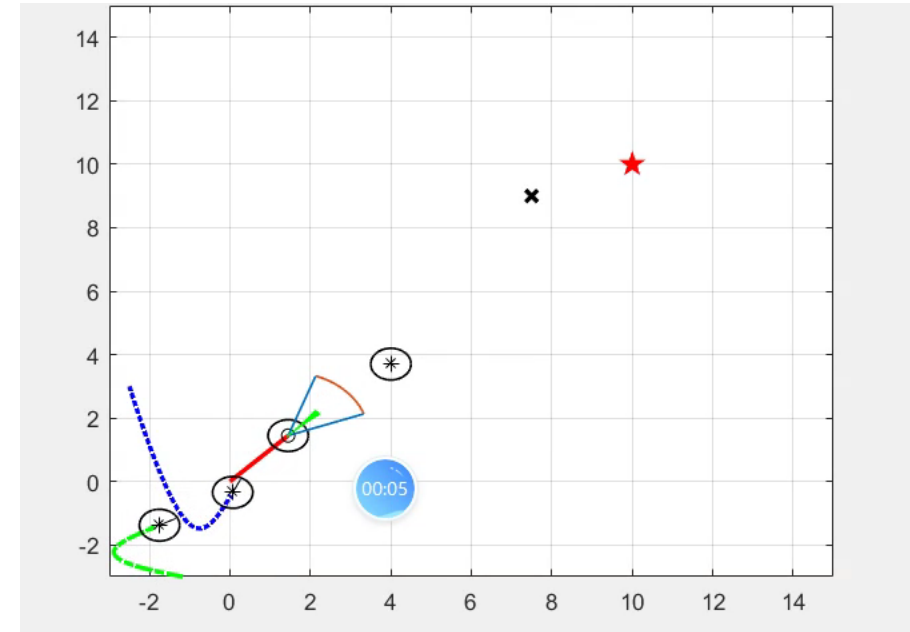
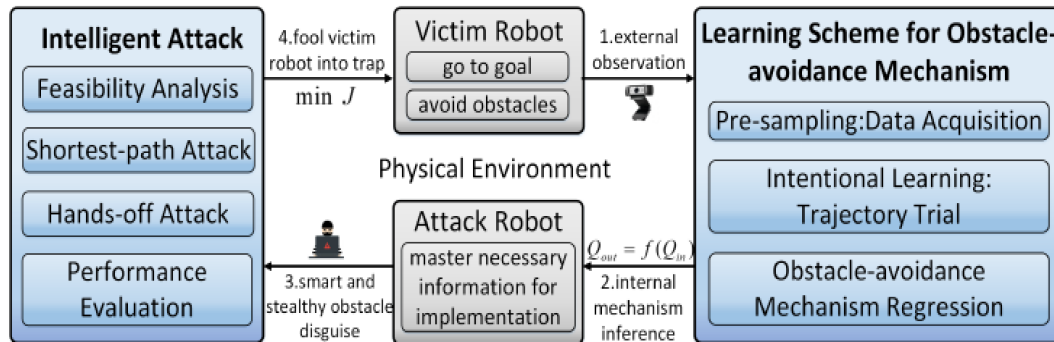
Research works

- Y Li, J He, C Chen, and X Guan, “[Intelligent Attack against Mobile Robots with Obstacle-avoidance](#)”, arXiv preprint, 2019.
- Y Li, J He, C Chen, and X Guan, “[Learning-based Intelligent Attack against Formation Control with Obstacle-avoidance](#)”, IEEE ACC, 2019.
- Y Li, H Wang, J He and X Guan, “[Optimal Topology Recovery Scheme for Multi-robot Formation Control](#)”, IEEE ISIE, 2019.



Scenario

- The architecture of the learning-based intelligent attack

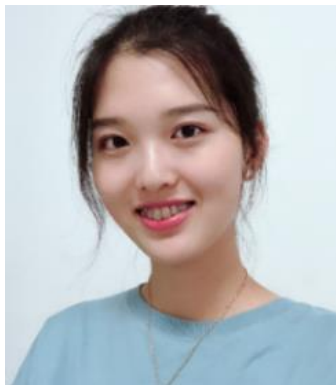


Intelligent attack against formation

- 3 robots, straight line formation
- Goal (10,10)
- Attacker (4,3.8)
- Trap (7.5,9)

Form the shape
→ Attack leader
→ Trajectory changed
→ Move into trap

Multi-Agent Cooperation and Inference



Qing Jiao (焦青)

Ph.D Candidate, F19

- Top 1% student at Dept. of Automation, XMU
- Obtain scholarships at XMU for several times
- **Huang Zhongxian scholarship**
- Obtain **Triple-A student** at XMU for several times
- Excellent undergraduate thesis at XMU
- Intern at **University of Cambridge** and got A in concluding report

Research works

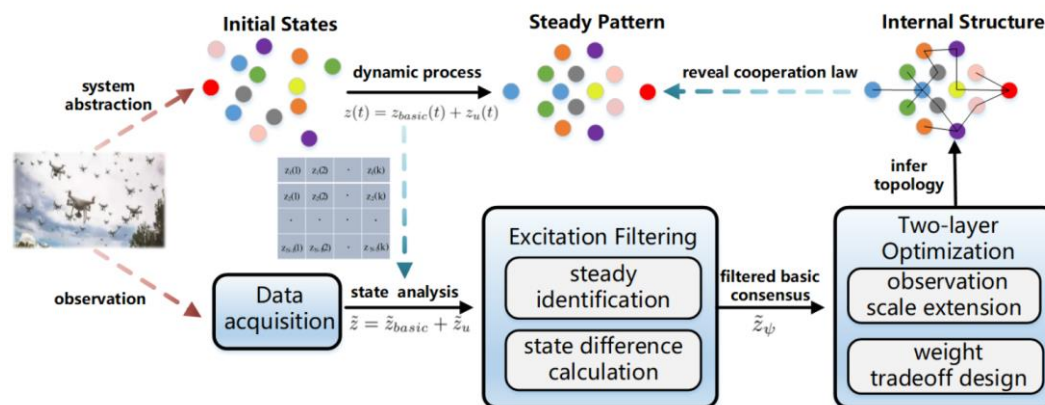
- Q. Jiao, Y. Li, J. He, "[Topology Inference for Consensus-based Cooperative Control](#)", submitted to IEEE CDC 2020.

Video material for submitted paper :

Multi-robot Targets Search under Multi-peak Distribution: A Dynamic HCA-based Approach

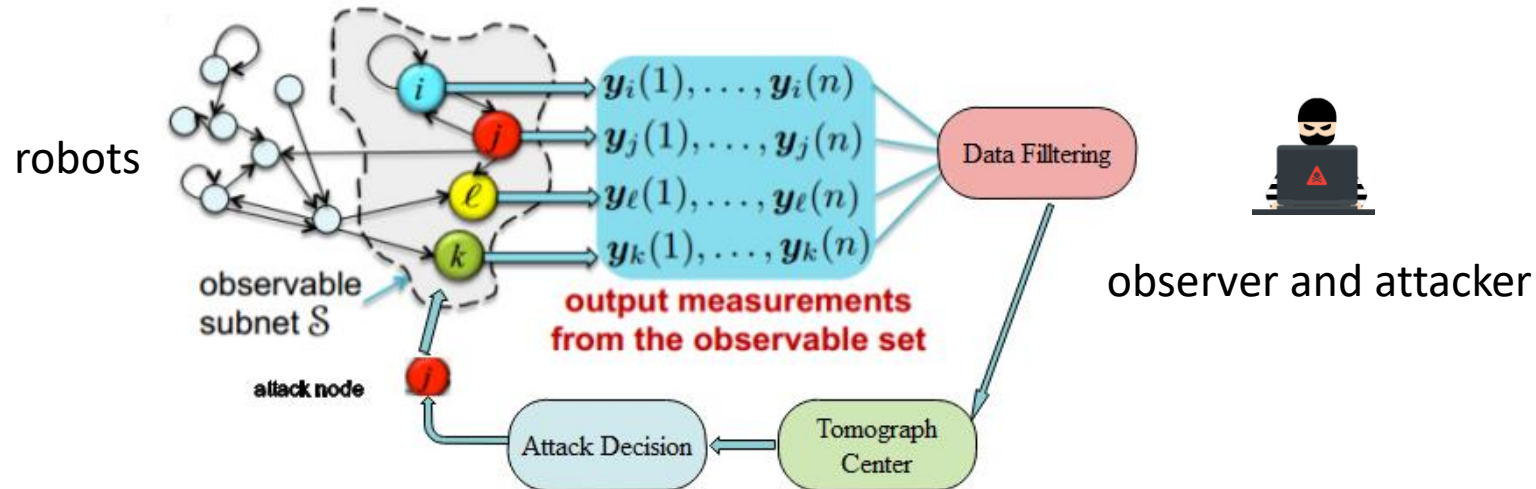
Qing Jiao, Yushan Li and Jianping He

Department of Automation, Shanghai Jiao Tong University,
and Key Laboratory of System Control and Information Processing,
Ministry of Education of China, Shanghai, China.



Topology Inference

Learning via external observation, and then attack the system



Basic problems

- what to observe, how to observe?
 - what to learn, how to learn?
 - what to attack, how to attack?
- ① Topology Inference: find the communication topology and attack
 - ② Motion rule learning: find the rule of obstacle avoidance and attack

Acknowledge the primary work of Cong Liu

- C. Liu, J. He, et al, "[Dynamic Topology Inference via External Observation for Multi-Robot Formation Control](#)", 2019 IEEE PACRIM



Han Wang (王汉) *Undergraduate, F16*

- Ph.D Offer from **University of Oxford**
- Summer intern at UCSB, supervised by Prof. **Francesco Bullo**
- Acquired **Excellent** Awards in Chuntsung project (蓉政项目)
- Published 2 papers on well-known conferences, and gave presentations
- Got an A+ on undergraduate thesis

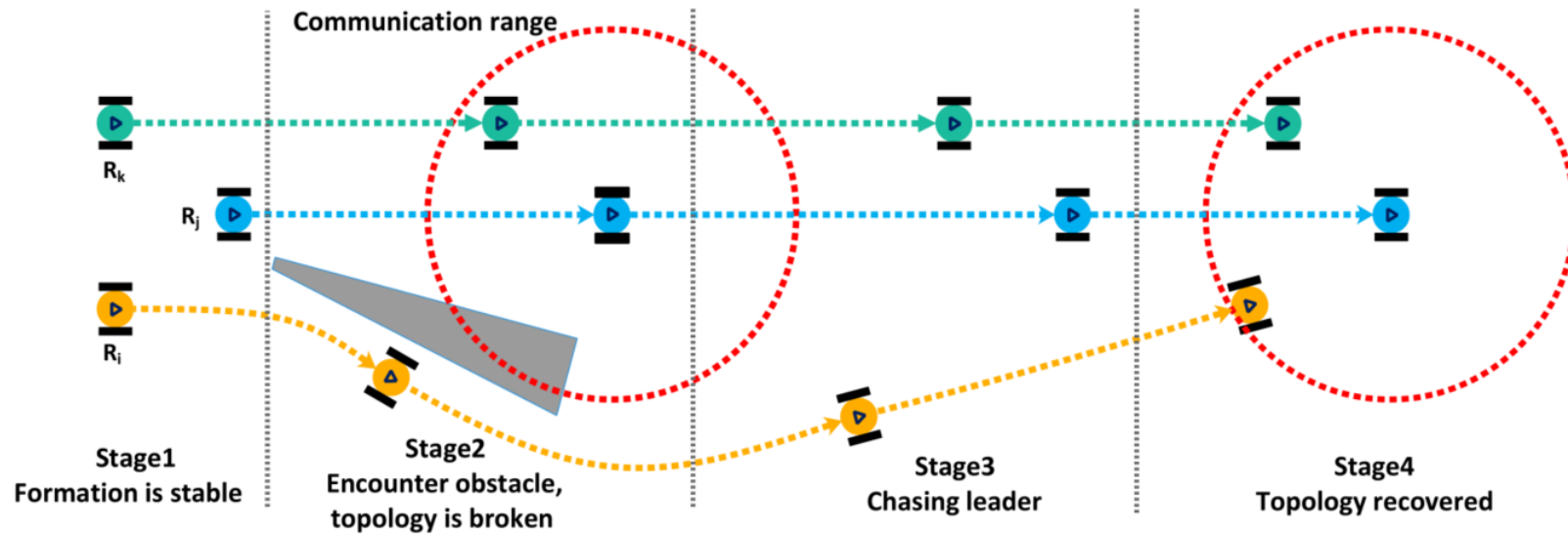
Research works

- **H. Wang**, Y. Li, J. He, *et al.*, “[Moving Obstacle Avoidance and Topology Recovery for Multi-agent Systems](#)”, IEEE ACC 2019.
- Y. Li, **H. Wang**, J. He, *et al.*, “[Optimal Topology Recovery Scheme for Multi-robot Formation Control](#)”, IEEE ISIE 2019.
- Y. Li, **H. Wang**, J. He, *et al.*, “[Distributed PDF Calculation in Network Systems](#)”, submitted to IEEE CDC 2020.



Formation Recovery Scheme

Basic idea



- Flexible moving obstacle avoidance algorithm
- Utilize historical data for motion estimation
- Design control strategy given different position relationship
- For infeasible situation, present the success probability

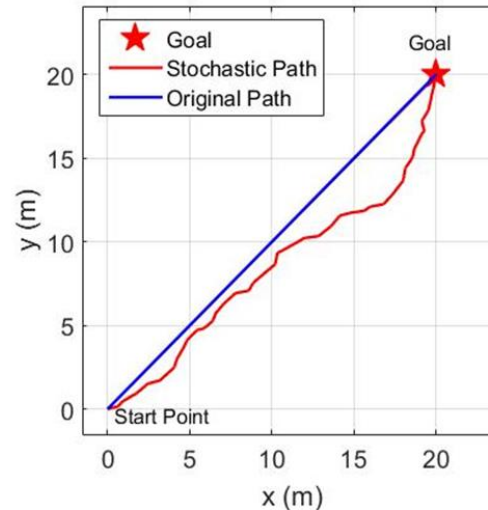
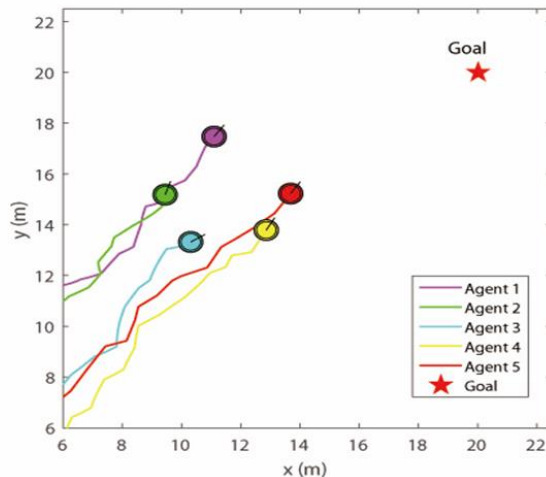


Jialun Li (李嘉伦) *Master Student, F19*

- Rank 1st at HIT, Dept. of automation
- **First prize** in 8-th National College Mathematics Competition
- **Meritorious Prize** in MCM
- National Scholarship for 3 times
- Triple-A student in Heilongjiang Province

Research works

- J. Li, J. He, Y. Li and X. Guan, “[Unpredictable Trajectory Design for Mobile Agents](#)”, IEEE ACC, 2020.
- J. Li, Y. Li, et al., “[Adaptive Task Allocation for Multi-agent Cooperation with Unknown Capabilities](#)”, IEEE VTC 2020.



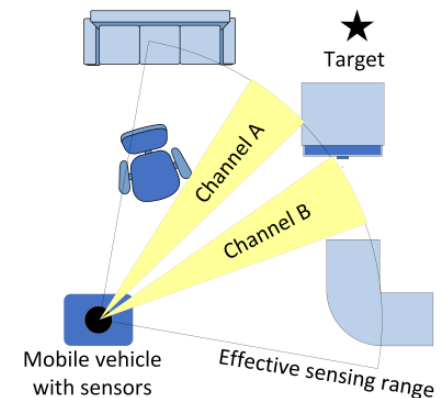
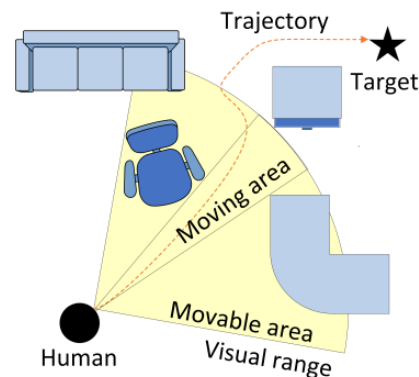
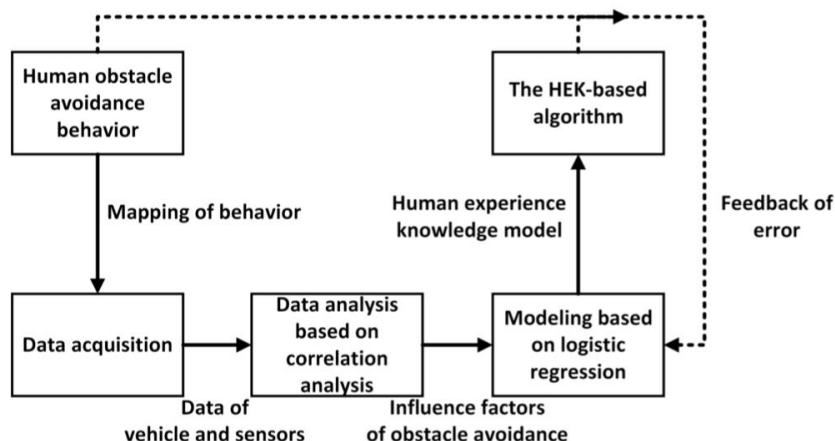


Hao Jiang (蒋浩) *Mater Student, F19*

- Rank 1st at SDU, Dept. of Automation
- Obtain National scholarship for 3 times
- Obtain First-class student award at SDU for 3 times
- Obtain Triple-A student award at SDU for 3 times
- Published 2 papers on well-known conferences

Research works

- H Jiang, et al, Y. Li, J. He, “[Obstacle avoidance algorithm based on human experience knowledge](#)”, IEEE VTC, 2020.
- H Jiang, X Ding, J he, et al, “[Information Value on Private State Inference in Network Systems](#)”, IFAC 2020.



Multi-Robot Localization



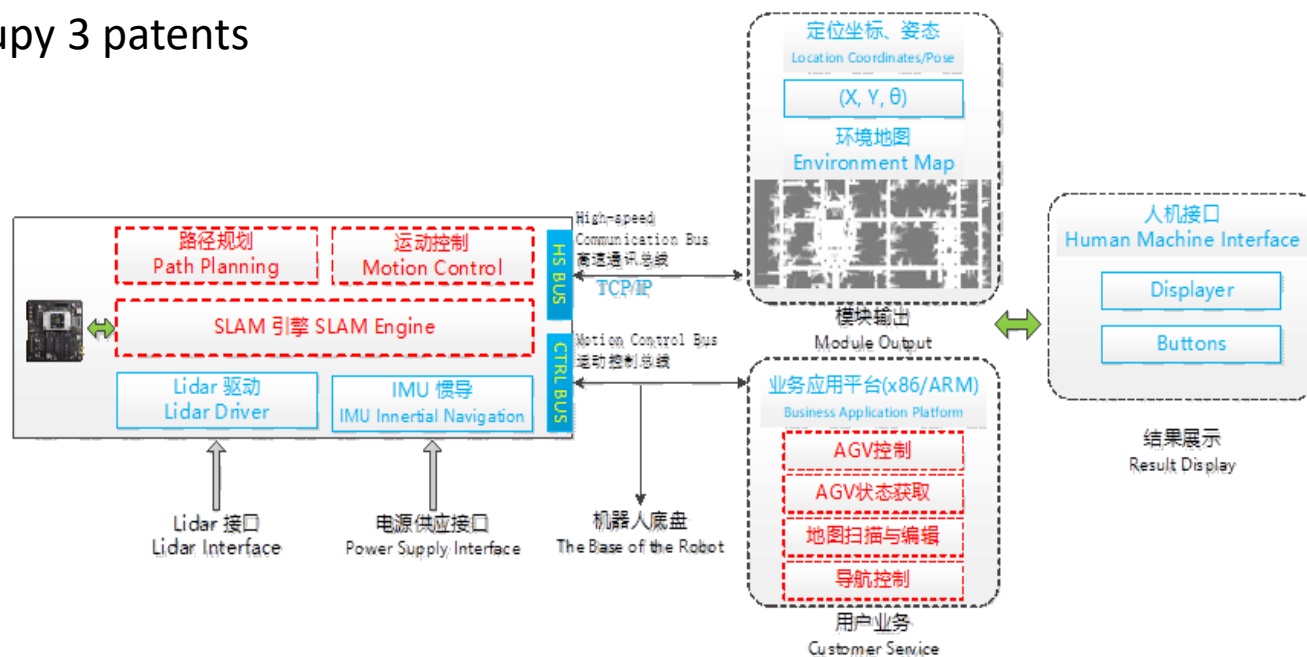
Hongbo Li (李鸿博)

Undergraduate, F19

- Ph.D offer from SUTD
- **Top ten excellent students** of 2017 in SJTU
- Obtain Triple-A student at SJTU for several times
- Assistant Engineer at **Changhong AI Lab**
- Occupy 3 patents

Research works

- 基于分布式协同的机器人编队通信恢复方法及机器人设备
- 基于粒子滤波器的多机器人编队定位方法及机器人设备
- 基于粒子滤波和视觉辅助的机器人定位方法



Acknowledgement for
长虹AI实验室

Data-Driven Control and Optimization



Xiaoyu Luo, **PhD**



Zhiyu He, **MS**



Mingjing Sun, **MS**



Mengzhou Ma, **MS**



Wanbin Han, **MS**



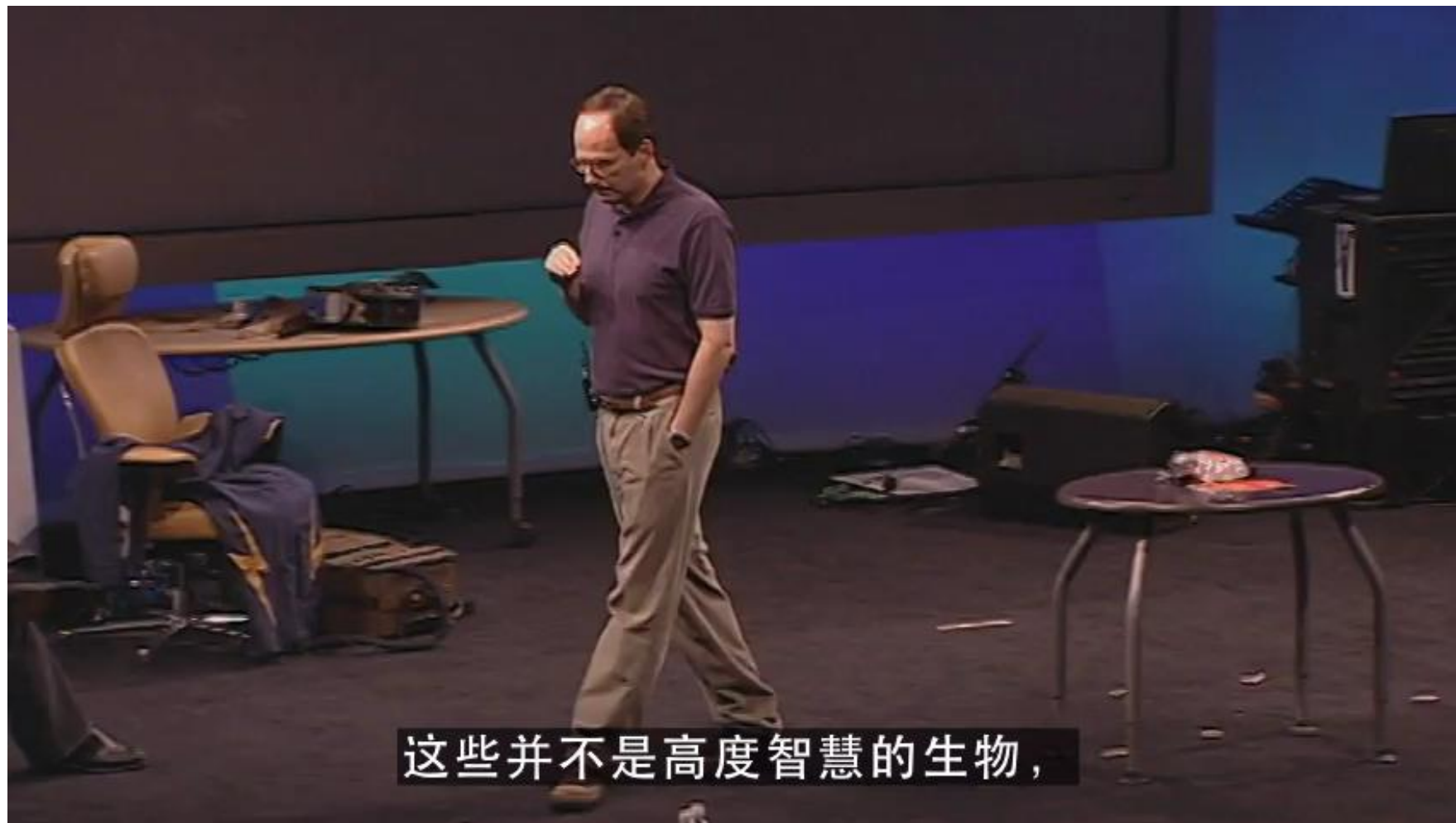
Yifan Cai, **UG**



Kunfang Zhang, **UG**



Chunzhi Guo, **UG**



Secure Cooperative Control

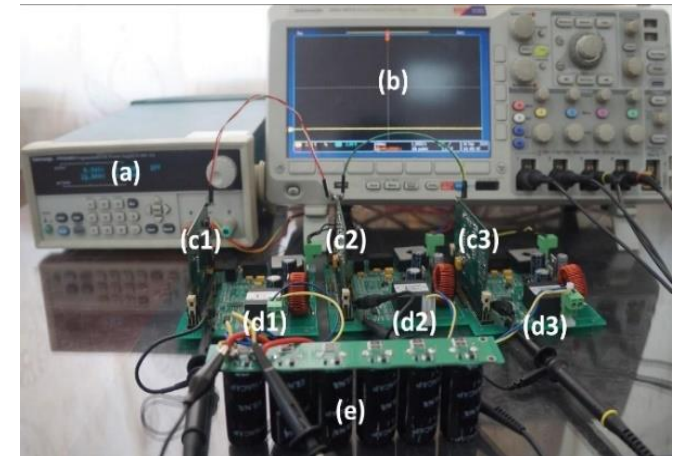
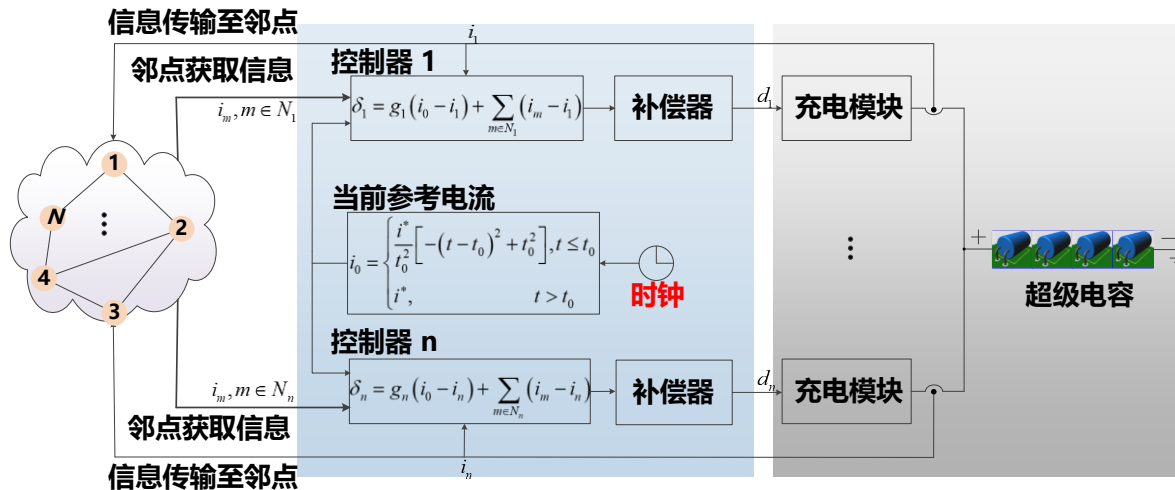


Xiaoyu Luo(罗潇雨) *Ph.D Candidate, F19*

- **Top 3%** student at TJU
- Obtain Tianjin Government Scholarship
- Obtain Zhuang Bingchang Scholarship
- **Hornorbale** Prize MCM

Research works

- X. Luo, J. He and S. Zhu, “On board Supercapacitors Cooperative Charging Algorithm: Stability Analysis and Weight Optimization”, IEEE ACC 2020.



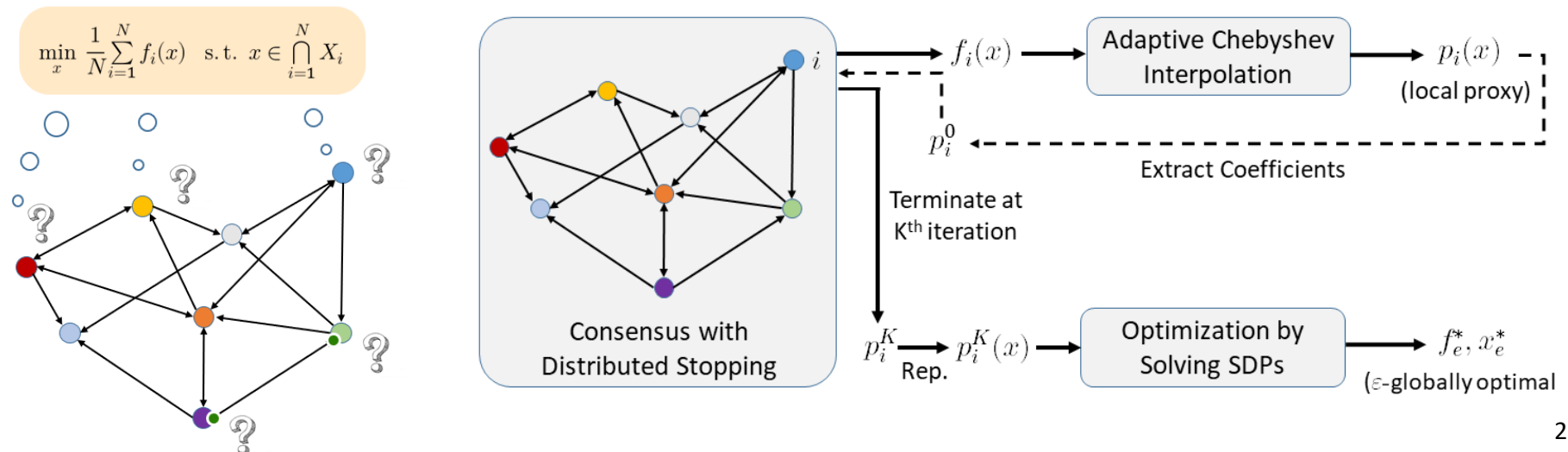


Zhiyu He (何志宇) *Master Student, F19*

- Received **Zhiyuan Excellent Students Scholarship**
- **Rank 1st** Dept. of Automation, SJTU
- Got an A+ on Undergraduate thesis

Research works

- Z. He, J. He, et al., “[CPCA: A Chebyshev Proxy and Consensus based Algorithm for General Distributed Optimization](#)”, IEEE ACC 2020.
- Z. He, J. He, et al., “[Constrained Distributed Nonconvex Optimization over Time-varying Directed Graphs](#)”, submitted to IEEE CDC 2020





Time: July 7th, Tuesday, 14: 30 - 16: 30
Zoom link: ethz.zoom.us/j/5258434015
Zoom meeting ID: 525 843 4015

智能控制系列报告

报告人: 何志宇 (上海交通大学博士生)
报告题目: Non-convex Distributed Optimization: Novel
Algorithmic Design and Arbitrarily Precise Solution

报告人: Jeremy Coulson (苏黎世联邦理工学院博士生)
报告题目: Regularized & Distributionally Robust Data-
enabled Predictive Control

主持人: 梅文俊 (苏黎世联邦理工学院博士后)
主办单位: 北京大学智能控制实验室



Zoom会议链接: ethz.zoom.us/j/5258434015
时间: 7月7日, 星期二, 14: 30 - 15: 30
会议 ID: 525 843 4015

智能控制系列报告

Non-convex Distributed Optimization: Novel Algorithmic Design and Arbitrarily Precise Solution

Abstract: This talk will introduce a novel distributed algorithm (named CPCA) by exploiting Chebyshev polynomial approximation, consensus and SDP theories, to solve a class of constrained distributed non-convex optimization problem. Different from existing iterative gradient-based method, this algorithm has the advantages of being i) computationally efficient in that no evaluation of gradients is required within the iterations, and ii) able to obtain arbitrarily precise estimates of global optimal solutions. We prove that with $O(m)$ zeroth-order oracle queries and $O(\log(m/\epsilon))$ rounds of communications, CPCA can yield ϵ globally optimal solutions for the considered problem, where ϵ is any arbitrarily small given tolerance, and m is the maximum degree of local approximations. Extensive simulation results validate the effectiveness of the proposed algorithm.



Speaker: 何志宇 (上海交通大学博士生)

Biography: Zhiyu He received his B.S. degree in Automation from Shanghai Jiao Tong University, Shanghai, China in 2019, and is currently a master student in the Department of Automation, Shanghai Jiao Tong University, supervised by Prof. Xiping Guan and Prof. Jianping He. His research interests lie in distributed optimization, learning and control of network systems.



主持人: 梅文俊 (苏黎世联邦理工学院博士后)
主办单位: 北京大学工学院智能控制实验室



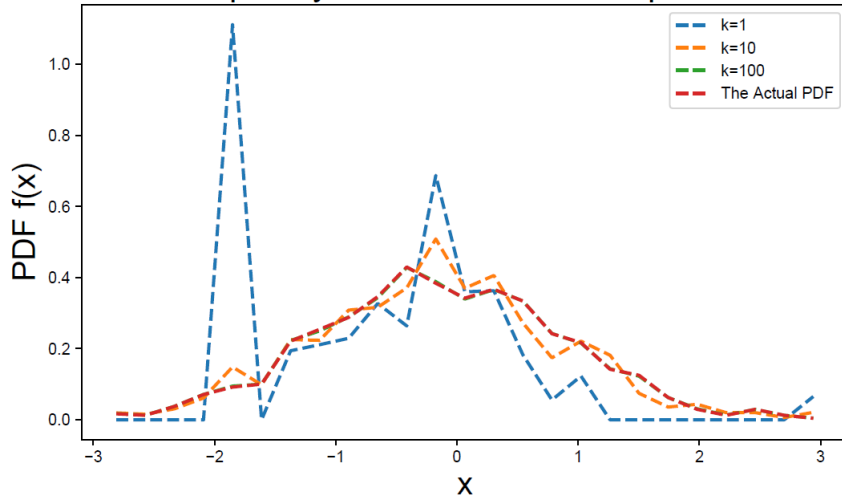
Yifan Cai (蔡一凡) *Undergraduate, F19*

- Ph.D offer from University of **Pennsylvania**, University of **Chicago**, **Purdue** University
- Obtain Huawei Scholarship
- Obtain SJTU scholarships for several times
- Joining our group through **PRP**

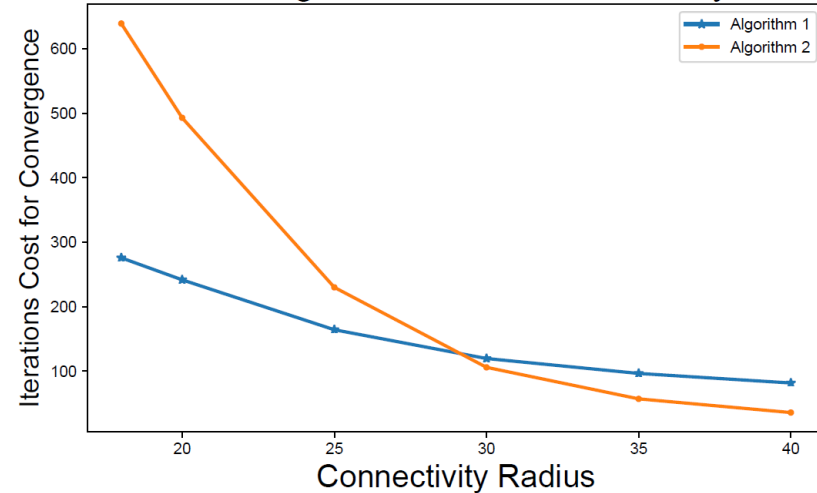
Research works

- Y. Cai, J. He, et al., "[Consensus-based Data Statistics in Distributed Network Systems](#)", *CDC 2018*

The Temporary Value of PDF in a Specific Node



Convergence Time vs. Connectivity



Glimpse of Daily Life



What's Our Training Goal ?

- **Establish** solid theoretical and technical/hardware foundation
- **Develop** independent research ability
- **Improve** academic writing and presentation quality

What Do You Need To Do ?

- **Select** solid your interested direction
- **Focus** on your research and balance class work
- **Devote** time on both theory and platform
- **Collaborate** closely with seniors/peers
- **Report** your progress timely

What Will You Acquire

- Chances to talk with distinguished domestic and abroad researchers
- Publish your 1st-author paper on top conferences and journals
- Attend academic conference abroad with fully funded
- Exchange Opportunities to well-known abroad universities

How To Join Us?

- Email to Prof. He (jphe@sjtu.edu.cn) or Dr. Li (yushan_li@sjtu.edu.cn) with your CV, transcript and research experience (not necessary)
- We will appoint an online meeting with you via e-mail

PRP, Chuntsung Projects, Undergraduate thesis
are welcomed to apply !



Contact US!

Q&A

Thank You!