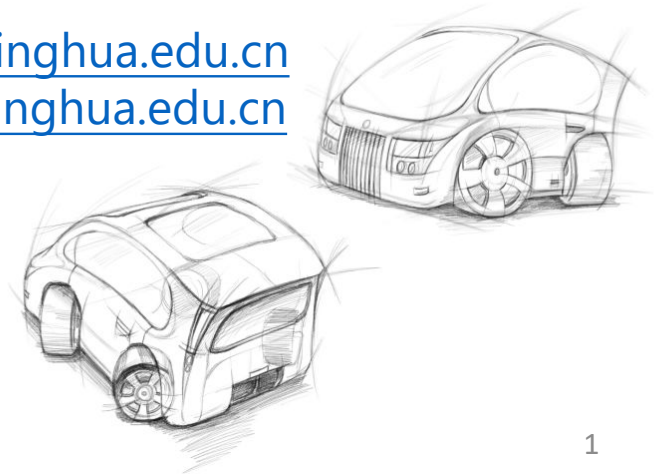
灵巧自主车项目

Agile Vehicle Project

Future Systems Lab
Tsinghua University
Haoguang Yang: yhg14@mails.tsinghua.edu.cn
Jiongming Shi: shijm15@mails.tsinghua.edu.cn
2017.5.15



Starting Point

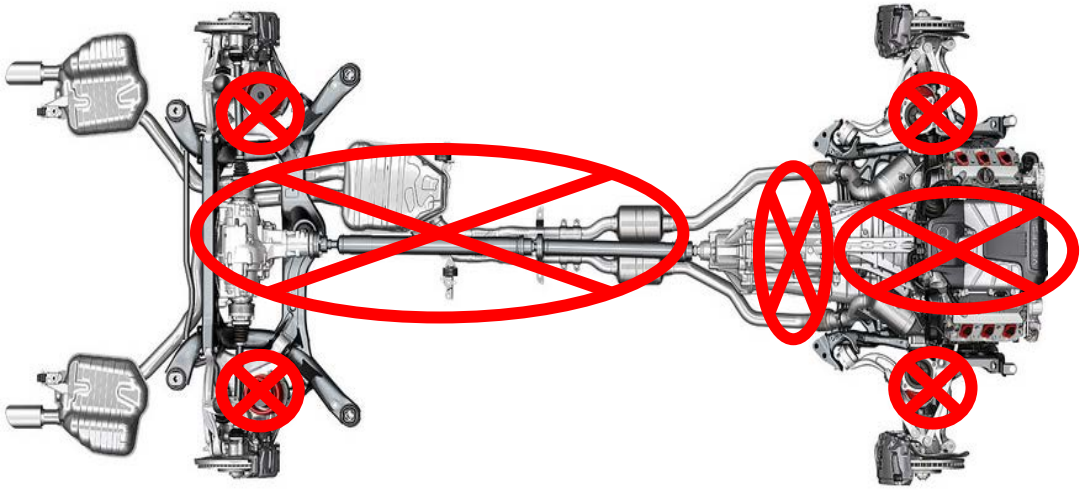
Critical Problem of Developing Automated Driving: A commercialized Vehicle

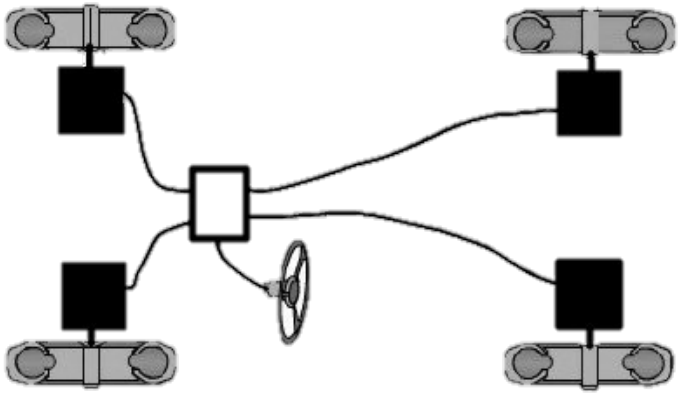
Why: There are too many companies in the area, include major car companies. Car companies definitely will use their own technologies.

Answer: Develop our own vehicle

Innovation

Simplicity and Efficiency





Innovation

Flexibility

Driving Pattern

	Moving Pattern	Model	Control
Traditional Driving	Small turning angle Large turning radius	Simple Small DOF	Steering Wheel; Drivers need to learn to drive
Intuitive Driving	Large turning angle Small turning radius	Complicated Large DOF	Computer-Aided Control; Similar with human ambulation,
Automated Driving			Computer Control; No participation of human

Goal

➡ OUR SOLUTION

Current

1 Two Wheel Steering

2 Four Wheel Steering

Intuitive

1 In-situ Steering

2 Omnidirectional Steering

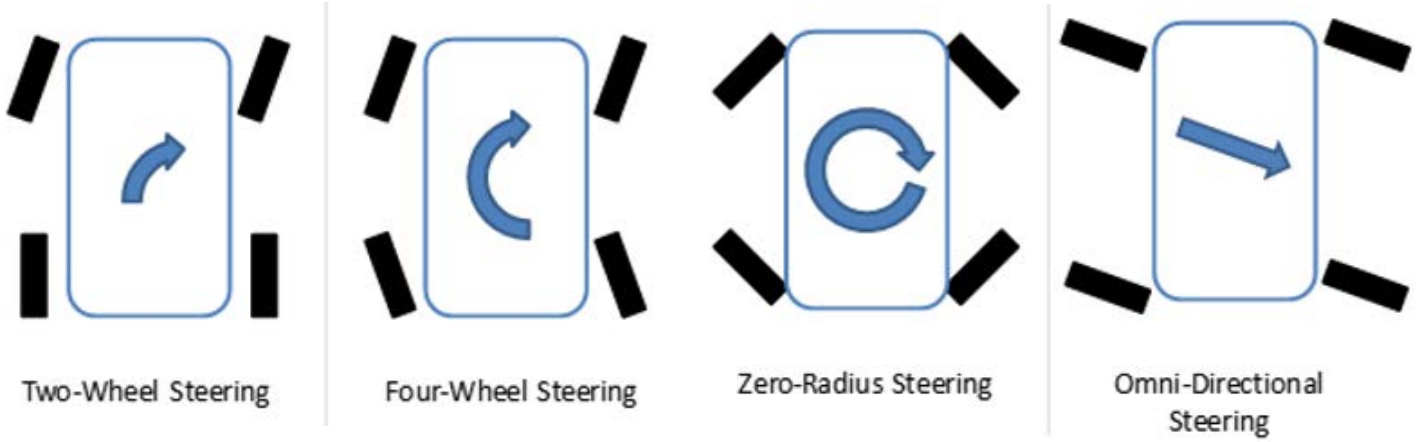
3 Human-in-the-loop

Core

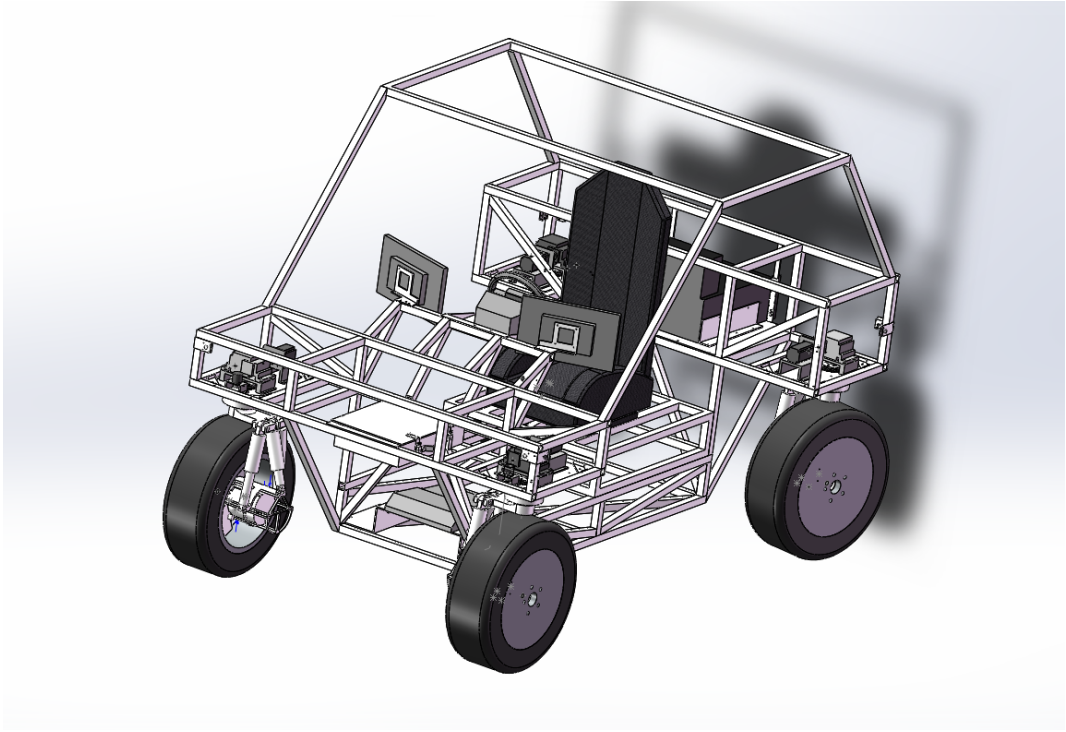
1 Omnidirectional independent suspension

2 Distributed Control

3 HITL Control System

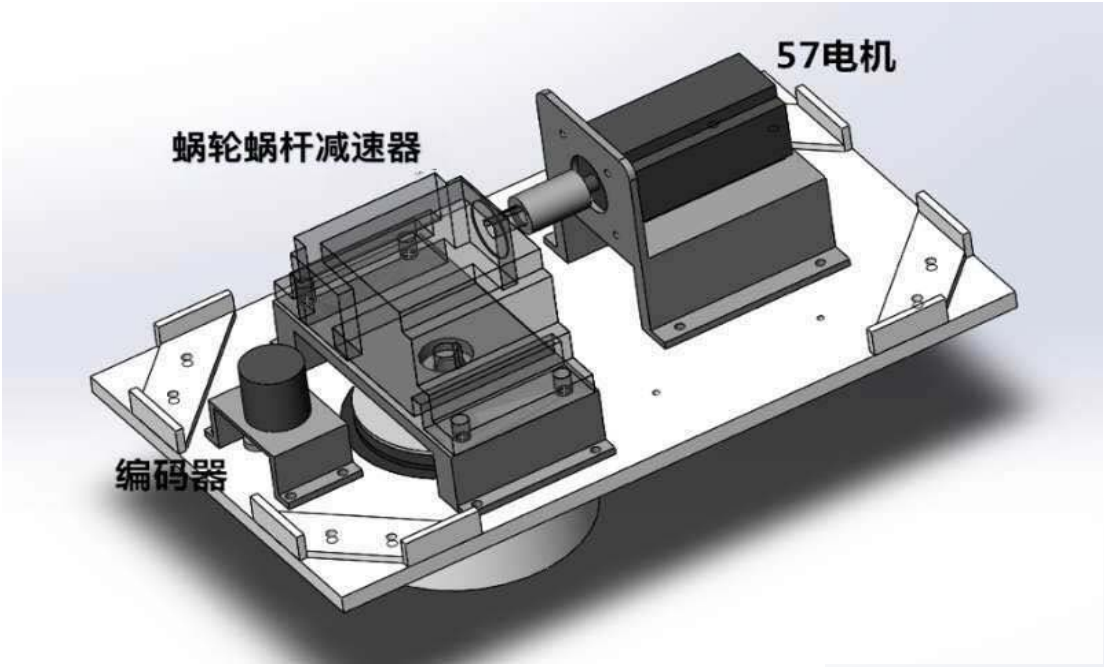


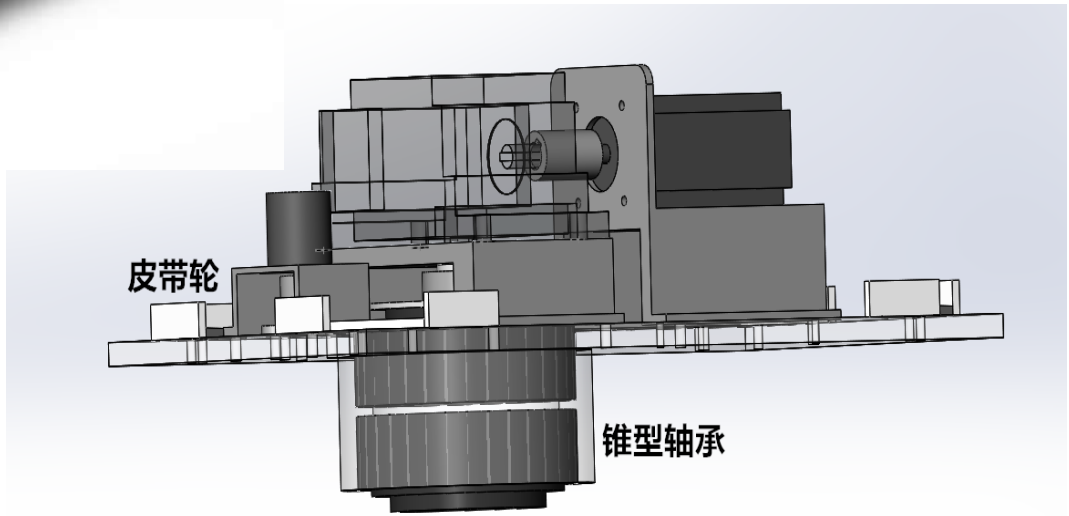
Mechanical Design | CAD Model

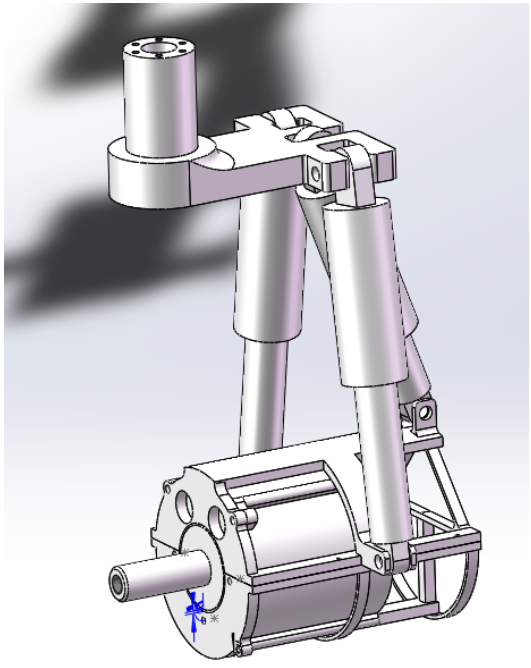


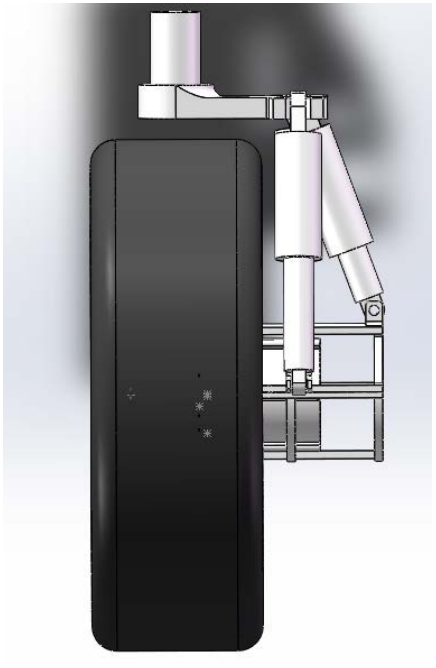
Conceptual Graph of
Agile Vehicle

Mechanical Design | Steering System



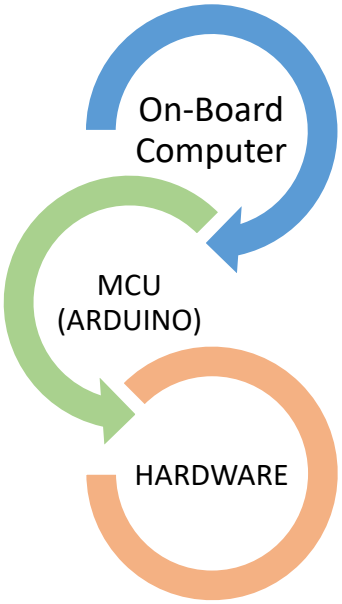


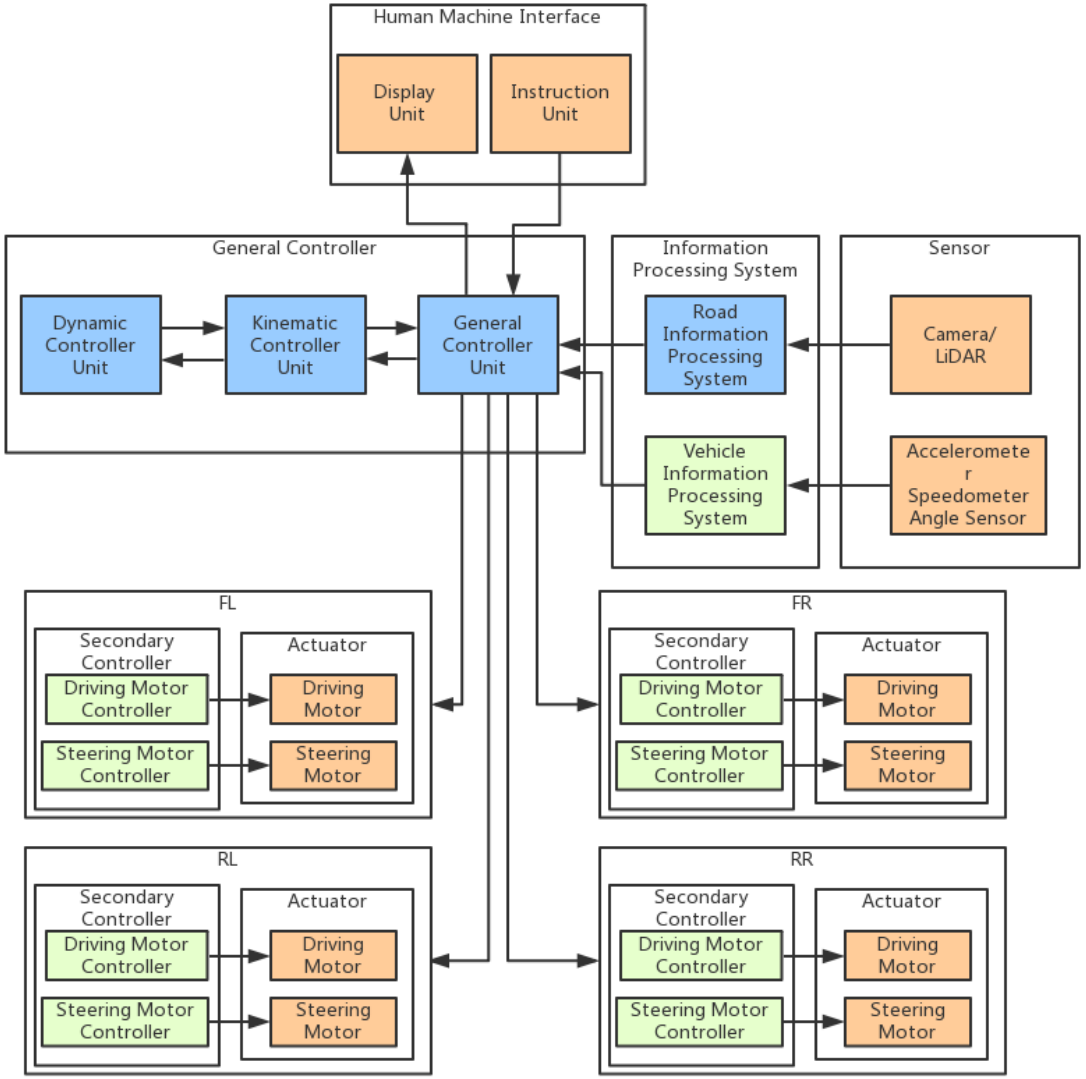




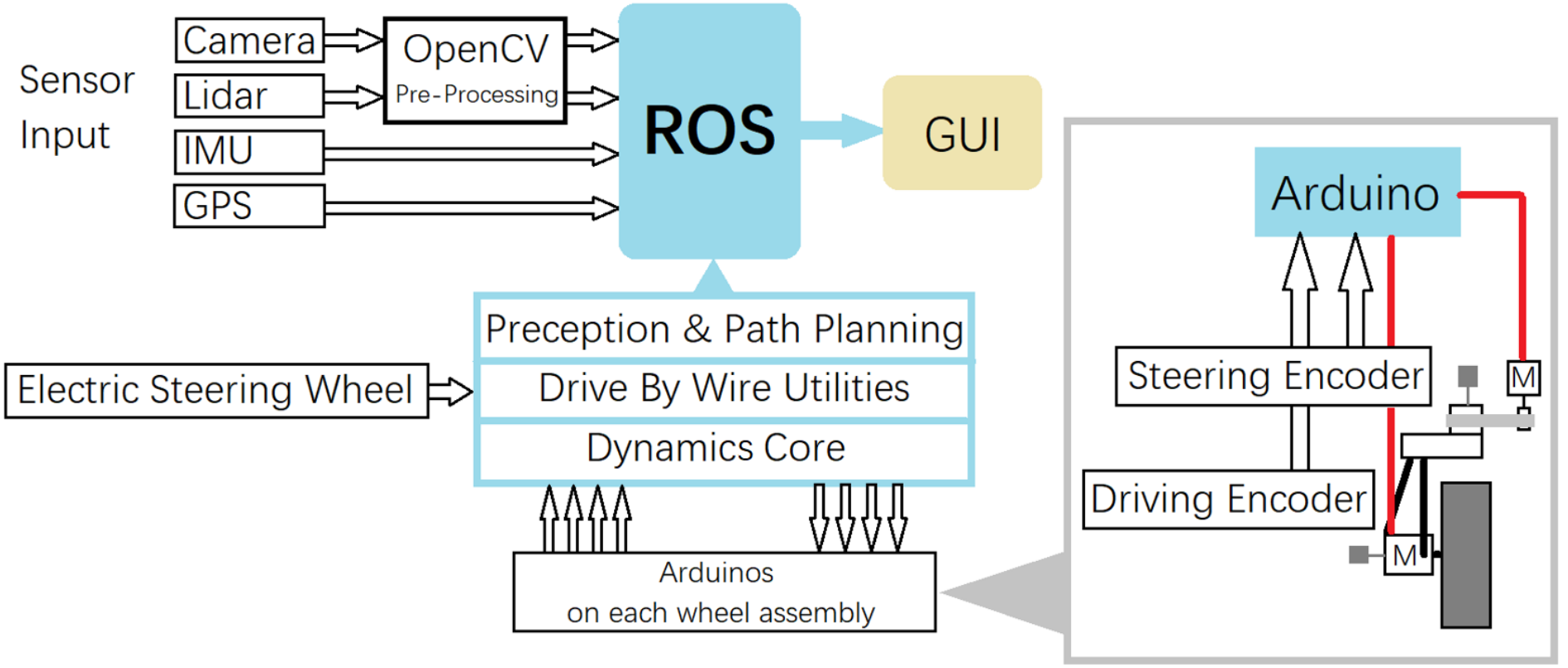
The pyramid-shaped damping mechanism

Control System Architecture



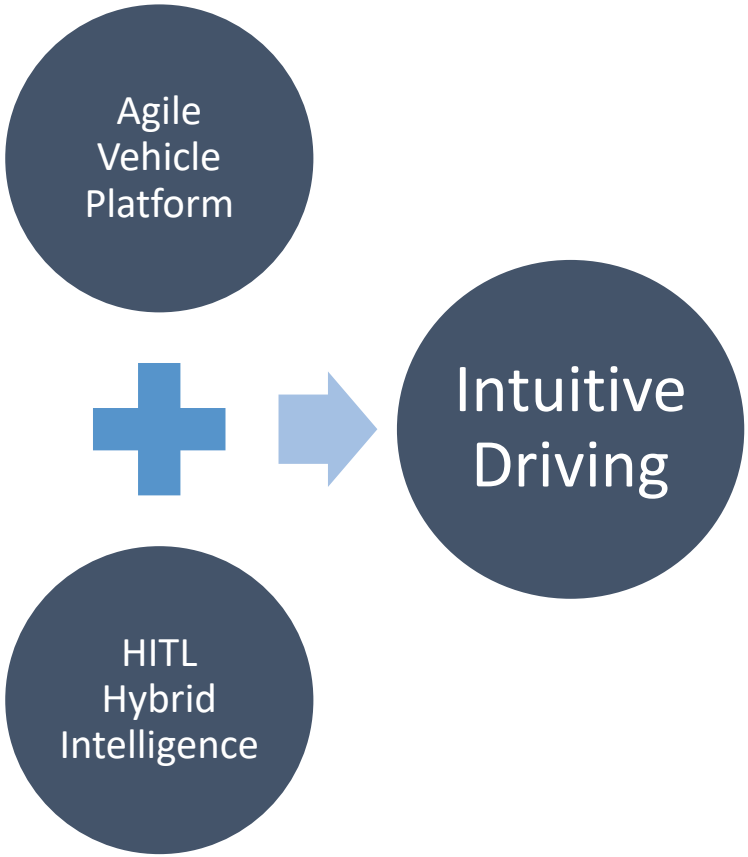


Control System | Deployment

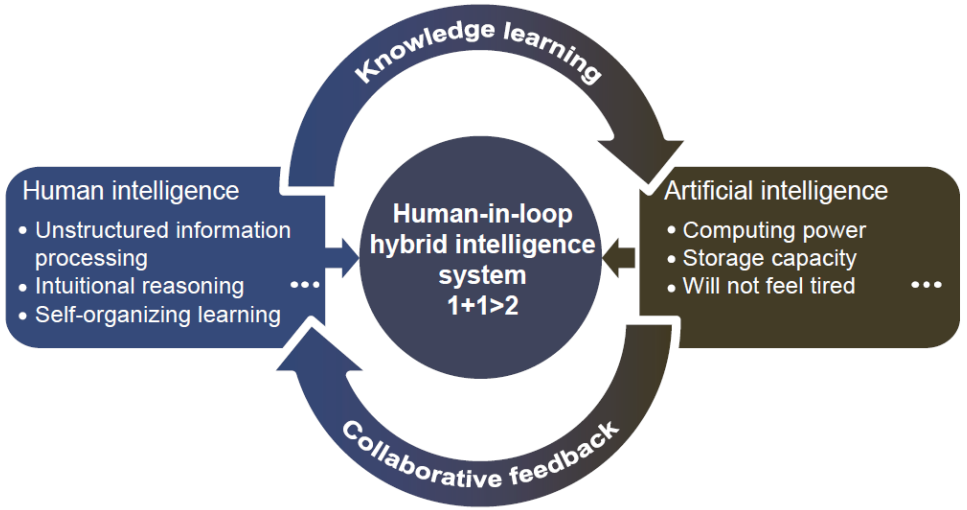


Intuitive Driving

➡ OUR SOLUTION



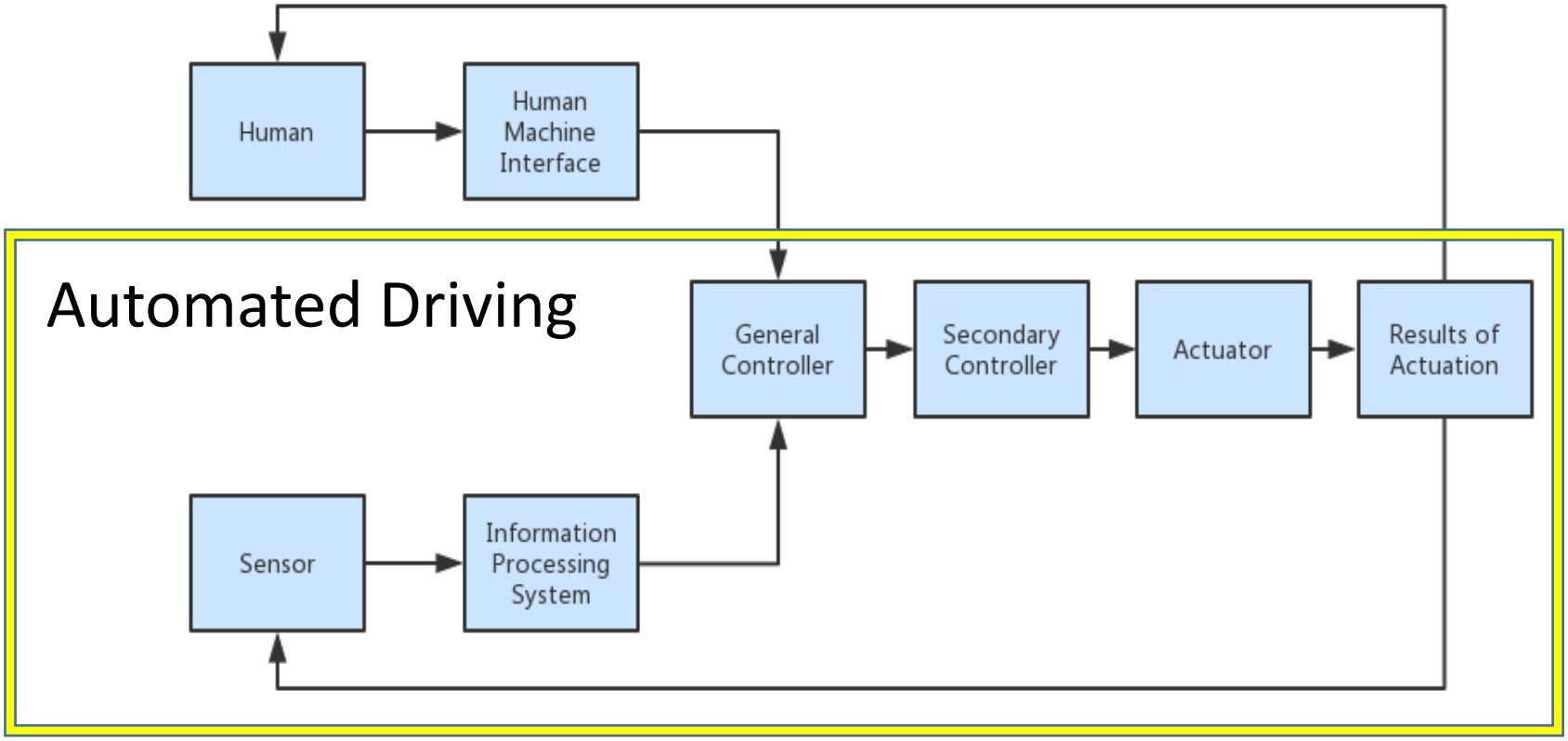
Human-in-the-loop (HITL)
hybrid-augmented intelligence



Our Control Architecture with human in the loop

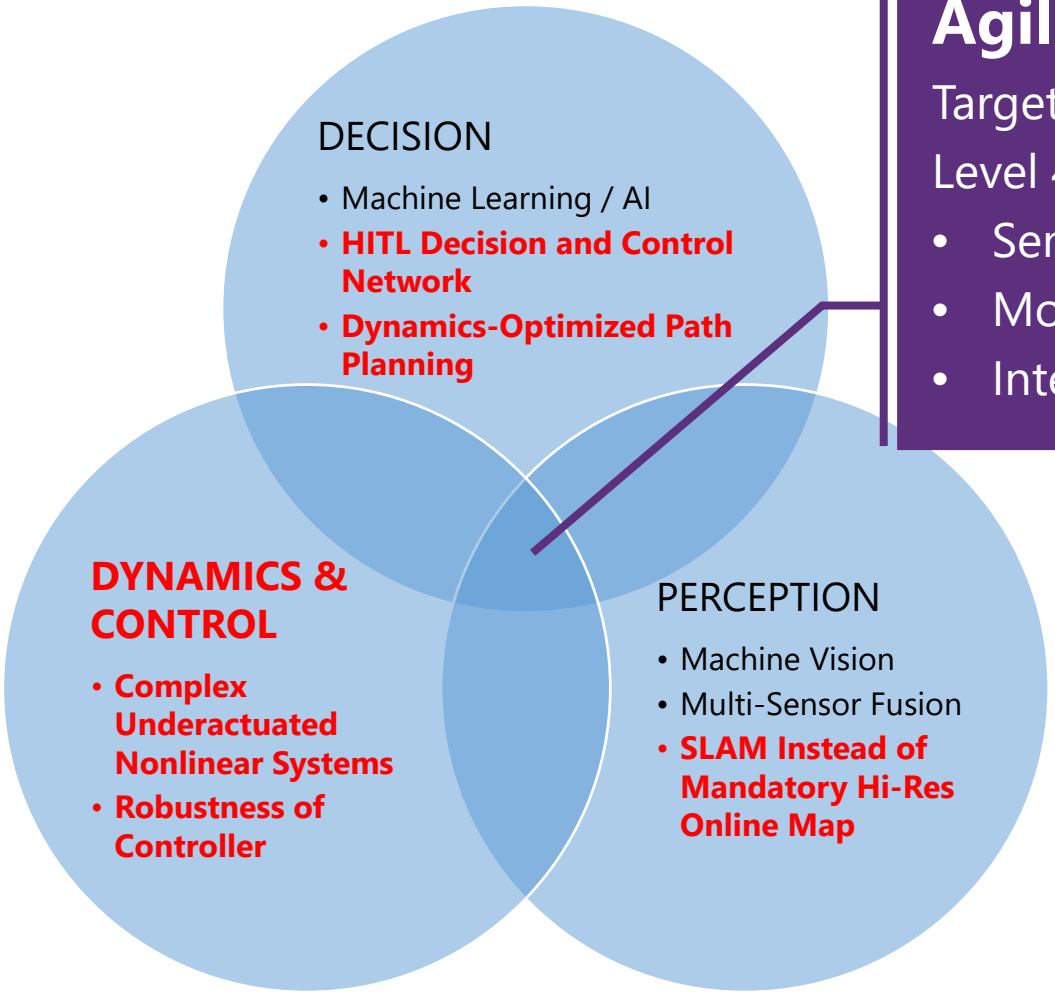
Intuitive Driving

➡ OUR SOLUTION



Our Control Architecture with human in the loop

Intuitive Driving



Agile Vehicle

Targeted to Realize

Level 4+ Autonomous Driving

- Sense+
- Motion+
- Interactive+

Conclusion

Design a novel Agile Vehicle platform

- Improve flexibility
- Increase efficiency
- Simplify structure

Propose the Intuitive Driving pattern

- Set up Human-in-the-loop control strategy
- Ease the burden of driving

Blueprint of Future Vehicle

Air+O

1 **Agility** -> suitable for urban traffic

2 **Intelligence** ->Realize and develop intuitive driving with HITL intelligence along with unmanned driving

3 **Responsibility** ->Battery! Employment promotion; green power utilization; price control

4 **Openness** ->Provide a real platform for application development on mobile vehicles

Project Outcomes

Patents

1. Xuexuan Zhao, Zilin Zhu, Jiongming Shi, Gangtie Zheng. *Control Systems of Four-Wheel-Independent Omnidirectional Vehicle based on Intuitive Driving Concept.*

2. Haoguang Yang, Qizhong Li, Boxin Li, Yu Chen, Zhengkun Gao, Jiongming Shi, Gangtie Zheng. *Omnidirectional single-sided independent suspension system.*

3. Zhengkun Gao, Qizhong Li, Yu Chen, Boxin Li, Haoguang Yang, Jiongming Shi, Gangtie Zheng. *Innovative Four-Wheel-Independent Driving and Steering Omnidirectional Electric Vehicle System*

Thanks