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汽车研究所

Automobile Research Institute

机械与车辆学院

Innovation and Excellence

北京理工大学
Beijing Institute of Technology

教授介绍 Professor Introduction

陈慧岩 教授

陈慧岩，工学博士，北京理工大学机械与车辆学院教授，车辆工程专业博士生导师。2008 年入选国防科工局国防科技创新团队带头人。主要研究方向为智能车辆技术，车辆信息技术，车辆传动系统自动操纵与自适应控制理论、方法，车辆动力传动一体化控制技术。获得国家科技进步一等奖 1 项，部级科技进步一等奖 1 项、二等奖 5 项，获得国家教学成果二等奖 1 项，获得北京市优秀教学成果奖 1 项。授权发明专利 8 项。在国内外重要学术刊物上发表学术论文 80 余篇，其中被 SCI/EI 收录 67 篇。

Professor CHEN Huiyan is the Defense Technology Innovation Team leader of the National Defense Science and Industry Bureau in 2008. His main research fields are intelligent vehicle technology, vehicle information technology, vehicle driveline automatic manipulation and adaptive control theory and methods, and integration of the vehicle power train control technology. He has been awarded the first prize of National Award for T Progress in Science and Technology one time, the first prize of ministerial-level Award for Progress in Science and Technology one time, the second prize of ministerial-level Award for Progress in Science and Technology five times, and Beijing outstanding teaching award one time. Up till now, he has published 8 invention patents, and 80 academic theses, of which 67 ones are recorded in SCI/EI.

陈思忠 教授

陈思忠，工学硕士，北京理工大学机械与车辆学院教授，车辆工程专业博士生导师，现任中国汽车工程学会车身专业委员会委员。主要研究方向为轮式车辆整车性能动态仿真与系统匹配；车身结构动力学与人体工程学；多轮转向仿真、控制与试验技术研究；越野汽车悬架虚拟设计与性能评价。主持完成"某伞兵突击车"的工程开发；研制过程中攻克伞兵突击车总体、悬架、传动三大技术难点；该项目填补了我军空降兵装备的空白，目前已装备部队。主持开发了"QCJ7082 微型轿车车身设计技术开发"，该项目是企业和北京理工大学共同承担的国家计委立项的*军转民*项目。完成了"轮式装甲车辆电子控制全轮转向系统及车轮纵向力控制系统（ABS）技术研究"。发表论文 30 篇；设计发明专利 6 项。目前承担"空降型牵引车的工程开发"、863 燃料电池城市客车项目子课题-轻量化设计任务、轮式车辆多轮转向技术研究以及越野车悬架设计方法研究等项目。

Professor CHEN Sizhong is the vehicle body committeeman in the China Society of Automotive Engineers. His main research fields are dynamic simulation and system match of wheeled vehicle performance, dynamics and ergonomics of body structure, multi-wheel steering simulation, control and test technology, and virtual design and performance evaluation of the suspension in off-road vehicle. He presided over completing engineering development of a parachute assault vehicle, and solved three major technical difficulties of the overall body, suspension, and transmission to design the parachute assault vehicles. The project filled the gap of the Airborne’s equipments, and has armed the military. He presided over the development of the "QCJ7082 mini-car body design technology development", which was one of the State Planning Commission's defense conversion projects undertaken by the enterprise and the Beijing Institute of Technology jointly. He completed the technology research in “electronic control systems, all-wheel steering system and wheel longitudinal force control system (ABS) in the wheeled armored vehicle”. He has published 30 theses and 6 innovation patents. Recently, he is undertaking several projects such as “engineering development of Airborne-type tractor”, sub-topics of one 863 Project -- city bus using fuel cells -- lightweight design tasks, wheel steering technology research for multi-wheeled vehicle, as well as the suspension design research projects of the off-road vehicle.

刘昭度 教授

刘昭度，工学博士，北京理工大学机械与车辆学院教授，车辆工程专业博士生导师。现任“汽车动力性与排放测试”国家专业实验室副主任。中国汽车工程学会越野车分会理事。主要研究方向为车辆电子技术（ABS、ASR 及 ACC 等），车辆制动系统设计及计算，车辆实验技术，车辆检测技术与设备，车辆总体设计与理论。承担课题"汽车底盘测功机系统和尾气采集系统联机控制装置开发";承担"九五"课题"军用车轮四轮转向控制和车轮纵向控制（ABS/ASR）研究中"ABS/ASR"部分的研究，取得多项技术突破。承担福特----国家自然科学基金课题"ABS/ASR/ACC 集成化系统仿真研究"。发表论文 40 余篇。

Professor LIU Zhaodu is the incumbent "Car Power Performance and Emission Test" deputy director of National Professional Laboratory and the off-road vehicles branch governor of the Chinese Automotive Engineers Society. His main research fields are vehicle electronics (ABS, ASR and ACC etc.), vehicle brake system design and calculation, vehicle experimental techniques, vehicle detection technology and equipment, and the vehicle overall design and theory. He undertook the topic - “development of Automobile chassis dynamometer systems and exhaust collection system on-line control device”, the ninth Five-year plan - “study on the ABS / ASR" part of the military four-wheel steering and longitudinal control (ABS / ASR)”, which made a number of technological breakthroughs. He also undertook the Ford-National Natural Science Foundation topics.

——人员名单

序号	姓名	职称	研究方向
1	陈慧岩	教授	智能车辆与自动变速技术
2	席军强	副教授	车辆自动变速与车体控制技术
3	龚建伟	副研究员	智能车辆与移动机器人技术
4	翟涌	副教授	车辆电子技术
5	金辉	副教授	车辆电子技术
6	刘海鸥	副教授	车辆自动变速与车体控制技术
7	熊光明	副教授	智能车辆与移动机器人技术
8	陶刚	讲师	车辆电子技术
9	胡宇辉	讲师	车辆电子技术
10	姜岩	讲师	智能车辆技术
11	金亚英	高级工程师	车辆电子技术
12	赵亦农	实验师	机械设计
13	苏云生	高级技师	机械设计、加工
14	刘昭度	教授	车辆总体理论与现代设计
15	齐志权	讲师	车辆安全性、汽车制动防抱系统
16	马岳峰	讲师	车辆动力学及其控制、车辆安全性
17	陈思忠	教授	车辆总体技术、悬架系统理论、多轮转向系统理论
18	吴志成	副教授	车辆总体技术、悬架系统理论
19	杨林	讲师	悬架控制理论、多轮转向控制理论
20	张斌	工程师	悬架系统理论
21	赵玉壮	讲师	悬架控制理论
22	韩建保	副教授	车身设计

Num	Name	Professional Title	Research field
1	Chen Huiyan	Professor	Intelligent Vehicle and Automatic Transmission Technology
2	Xi Junqiang	Associate Professor	Vehicles Automatic Transmission and Vehicle Control Technology
3	Gong Jianwei	Associate Researcher	Intelligent Vehicle and Mobile Robotic Technology
4	Zai Yong	Associate Professor	Vehicle electronic technology
5	Jin Hui	Associate Professor	Vehicle electronic technology
6	Liu Haiou	Associate Professor	Vehicles Automatic Transmission and Vehicle Control Technology
7	XiongGuangming	Associate Professor	Intelligent Vehicle and Mobile Robotic Technology
8	Tao Gang	Lecturer	Vehicle electronic technology
9	Hu Yuhui	Lecturer	Vehicle electronic technology
10	Jiang Yan	Lecturer	Intelligent vehicle technology
11	Jin Yaying	Senior Engineer	Vehicle electronic technology
12	Zhao Yilong	Experimentalist	Mechanical design
13	Su Yunsheng	Senior Technician	Mechanical design, machining
14	Liu Zhaodu	Professor	Vehicle Overall Theory and Modern Design
15	Qi Zhiquan	Lecturer	Vehicle safety
16	Ma Yuefeng	Lecturer	Vehicle safety
17	Chen Sizhong	Professor	Vehicle overall technology,Suspension system theory,Multi-wheel steering system theory
18	Wu Zhicheng	Associate Professor	Vehicle overall technology,Suspension system theory
19	Yang Lin	Lecturer	Suspension control theory,Multi-wheel steering control theory

20	Zhang Bin	Engineer	Suspension system theory
21	Zhao Yuzhuang	Lecturer	Suspension control theory
22	Han Jianbao	Associate Professor	Vehicle body design

实验室简介 Brief Introduction

汽车研究所隶属于车辆工程系，由智能车辆研究团队、车身课题组、汽车安全课题组组成。承担多项国家(国防)重大基础科研项目和著名汽车企业合作项目，研究生课题基础与实践并重，并与多所国际名校联合培养。

汽车研究所现有教职工 22 人，其中教授 3 人，副教授 9 人，教师均为“车辆传动重点实验室”、“地面无人系统创新团队”及“仿生机器人与系统教育部重点实验室”成员。主要研究方向有：（1）车辆总体设计及理论；（2）车辆安全与人机工程；（3）车辆信息技术；（4）智能车辆系统理论及方法；（5）车辆自动操纵理论与设计；（6）多轮/全轮转向系统动力学及其控制；（7）油气/空气悬架系统设计及理论；（8）半主动/主动悬架系统动力学及其控制。

Automotive Research Institute, which belongs to the Department of Vehicle Engineering, is composited by Intelligent Vehicle Research Center, Car Body Lab and Automotive Safety Team. A lot of national or defense fundamental research funds and application projects from automotive companies are being investigated in these groups. All postgraduate students are involved in the projects, and some students are joint-cultivated in some international famous universities. Automobile Research Institute has a staff of 22 people, including 3 professors, 9 associate professors. All the teachers are members of "Science and Technology on Vehicle Transmission Laboratory", "Unmanned Ground

System Science and Technology Innovation Team" and "Bionic Robots and Systems, Ministry of Education Key Laboratory ". The main research areas include: (1) vehicle design and theory; (2) vehicle safety and ergonomics; (3) vehicles information technology; (4) intelligent vehicle systems theory; (5) automatic vehicle control theory and design; (6) multi-wheel/all-wheel steering system dynamics and control; (7) oil / air suspension system design and theory; (8) semi-active / active suspension system dynamics and control.

——承担项目 Project

北京理工大学汽车研究所先后承担了包括国家自然科学基金、国家 863 计划、国家高新工程以及国防基础研究在内的百余项科研任务。

1. “七五”期间，承担了国防预研项目：履带车辆自动变速操纵基础理论研究。

2. “八五”期间，承担了国防预研项目：履带车辆自动变速操纵原理样机研究、7B8 军用地面机器人。

3. “九五”期间，承担了国防型号项目：外贸履带车辆自动变速操纵系统开发；国防预研项目：军用地面机器人；部委科技预研项目：“伞兵突击车设计与研制”“QCJ7082 微型轿车车身正向开发设计技术研究”、“轮式车辆牵引力控制系统研究”、“电控全轮转向技术研究”。

4. “十五” 期间，承担了国防型号项目：外贸重型轮式越野车辆自动机械变速器（AMT）系统开发、数字化电液自动操纵技术研究、履带车辆自动操纵技术研究；部委科技预研项目：“空投型牵引车的总体设计与研制”“高性能越野汽车悬架技术研究”、“轮式多轴车辆多轮转向技术研究”、“中型越野车油气悬架系统设计与研制”；国家 863 项目：纯电动客车 AMT 开发。

5. “十一五”期间，承担了国防型号项目：重型轮式越野车辆自动机械变速器（AMT）多个型号开发、履带车辆综合传动装置自动操纵多个型号项目开发、履带双流机械变速器自动操纵外贸型号开发；国防科技创新团队项目；部委科技预研项目，“轻型高性能越野车悬架技术研究”、“重型高性能越野车油气悬架设计及控制系统研发”、“反恐全地域轻型机动平台关键技术研究”、“电动全轮转向技术研究”；国家 863 项目：重型商用车 AMT 开发；国家自然科学基金面上项目：基于行驶环境识别的汽车智能换挡系统理论与关键技术研究（2006.1-2008.12）；国家自然科学基金重点项目：无人驾驶车辆智能行为综合测试环境设计与测评体系研究（2009.1-2013.12）

6. “十二五”期间，承担国防预研项目：传动故障诊断技术研究、轮式车辆液力机械自动变速技术（AT）研究、重型轮式车辆自动机械变速器多个型号开发、载荷谱编谱技术研究、电液操纵理论研究；部委科技预研项目：“电液控制多轮/全轮转向系统研究”、“重型高性能越野车的交叉互连油气悬架系统研究”、“高档乘用车主动控制悬架技术研究”、“高维非线性振动状态观测算法研究”；国家自然科学基金培育项目：无人驾驶车辆认知能力测试及验证环境设计与实现（2012.1-2014.12），国家自然科学基金面上项目：高速地面车辆主动危险规避最优运动规划与控制的动力学模型分析（2013.1-2016.12）；国家 863 项目：混合动力控制策略解析、CVT 技术研究、混合动力客车 AMT 开发。

Automotive Research Institute has undertaken dozens of scientific research projects entrusted by the National Natural Science Foundation of China, Ministry of Industry and Information Technology, Ministry of Education, General Armament Department, Research Institute of Arms and a number of enterprises and public institutions.

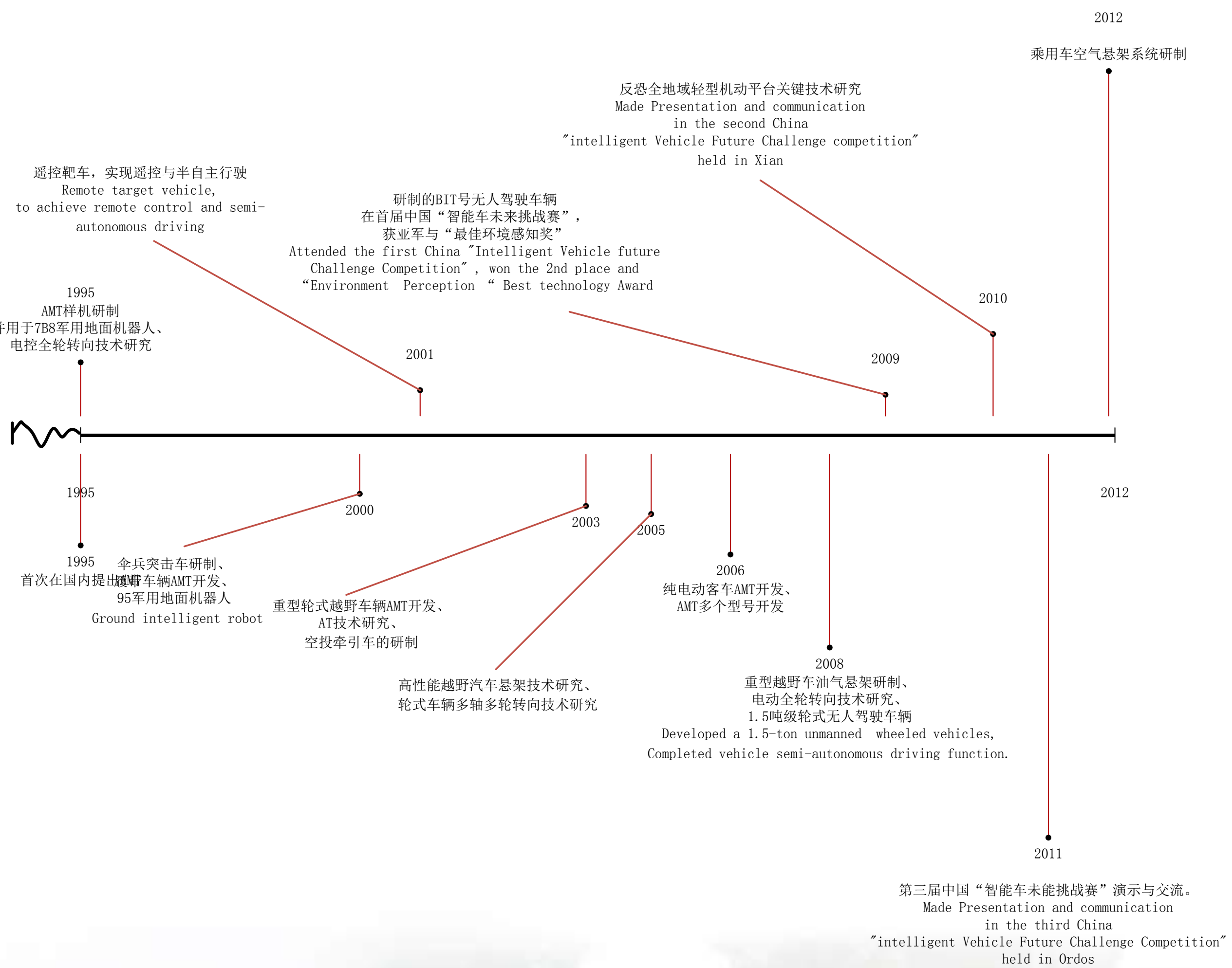
1. During the seventh five-year plan period , we successfully finished the National Defense Advanced Research Projects : basic theoretical research in automatic speed control on tracked vehicles
2. During the eighth five-year plan period, we successfully finished the National Defense

Advanced Research Projects: automatic speed control research in the tracked vehicle prototype, 7B8 military ground intelligent robots

3. During the ninth five-year plan period , we successfully finished the National Defense Projects: automatic transmission system development in tracked vehicles for foreign trade; the National Defense Advanced Research Project: Military ground intelligent robot. In addition ,we also undertook many technological pre-research projects from ministries: "Parachute assault vehicle design and development","QCJ7082 minicar body forward development and technological research", "Wheeled vehicle traction control system", "Electronically controlled all-wheel steering technology research".
4. During the tenth five-year plan period, we successfully finished the National Defense Projects: automatic mechanical transmission (AMT) system development in heavy wheeled off-road vehicle for foreign trade; the National 863 Projects: electric buses' AMT development. We were also committed many technological pre-research projects by ministries: "Airdrop type tractor's overall design and development", "High-performance off-road vehicle's suspension technology research," "Multi-wheel steering technological research of wheeled multiaxial vehicle", " design and development of oil and gas suspension system for medium-sized off-road vehicle".
5. During the eleventh five-year plan period, we successfully finished the National Defense Projects: automatic mechanical transmission (AMT) development in heavy wheeled off-road vehicle at several models, automatic manipulation development projects in integrated transmission of the tracked vehicle at several models; the National Defense Technology Innovation Team project; the National 863 projects: AMT development on Heavy commercial vehicles .We still had lots of project cooperation： "Lightweight high-performance off-road vehicle suspension technology" , "heavy-duty high-performance off-road vehicle oil and gas suspension design and development"," key technologies research of all terrain anti-terrorism light mobile platform ", "electric all-wheel steering technology research" from ministries. We are working on the Key Funding Project of NSFC: Research on Comprehensive Test Environment Design and Evaluation Architecture of Intelligent Behaviors for Unmanned Ground Vehicles (2010.1-2013.12).

During the eleventh five-year plan period, we successfully finished the National Defense Projects: transmission fault diagnosis research, hydraulic automatic transmission technology (AT) research for wheeled vehicles, and automatic mechanical transmission development on heavy wheeled vehicle at several models; the National Defense Basic Technology Research Projects: compiling load spectrum technology research, and electro-hydraulic control theory; the Fostering Project of NSFC: Test on the cognition ability of unmanned ground vehicles and design and implementation for the test environment(2012.1-2014.12); the General Project of NSFC: Dynamic Model Optimal Motion Planning and Control on Super-Speed Ground Vehicles' Active Risk Aversion (2013.1-2016.12); the pre-research projects by ministries: "Electro-hydraulic control multiple rounds / all-wheel steering system studies", "high-performance of heavy SUV's oil and gas suspension system for cross-connect research", "High-end passenger car active control suspension technology research", "High-dimensional nonlinear vibrational state observer algorithm research"; the National 863 Projects: hybrid control policy resolution, CVT technology research, and hybrid power buses' AMT development.

技术研发历程 History of IVRC Development



发展目标 Development Goals

技术研究：重点建设 8 个研究方向，在“车辆转向动力学控制技术研究”、“车辆自动操纵理论与设计”，“车辆悬架理论及其电子控制技术研究”，“智能车辆系统理论及方法”等研究方向上达到国内领先、国际一流水平，主持 1-2 项国家级重点科研项目；建成车辆悬架、转向系统及智能车辆技术的研发平台。

人才培养：培育 3-5 名在国内外有影响力的专家和高级工程人才；

行业服务：建成国际水平的工程研究和试验条件，为我国自主汽车技术的发展，提供悬架、转向、自动操纵、无人驾驶等领域系统理论和技术平台。

Technical research: Focus on eight directions and reach international level in 4 directions including "vehicle steering dynamics control technology", "vehicle automatic manipulation theory and design", "vehicle suspension theory and its electronic control technology research" and "intelligent vehicle systems theory and method". Take charge of 1-2 national major research projects and establish the innovative research base for the development of suspension and steering systems and intelligent vehicle technology.

Talent cultivation: Nurturing 3-5 influential experts and senior engineering personnel at home and abroad.

Establish world-class project research environment which can provide suspension and steering systems theory and technology and intelligent vehicle technology.

自动变速技术试验平台
Automatic transmission technology experiment platform

自动变速技术试验平台主要包括：自动变速器、电机、惯性系统、变频器和数据记录仪等，该平台可以进行自动变速器电控系统可靠性考核，换挡规律、换挡过程以及换档逻辑的性能验证；自动变速器动态性能试验等。

Automatic transmission technology experiment platform mainly includes: automatic transmission, motor, inertial systems, inverter and data logger, etc. This platform can estimate the reliability of electronically controlled automatic transmission system, verify the shifting schedule, logic processes and performance of shifting, and test the automatic transmission dynamic performance, etc.

8×8 转毂试验台
8 × 8 rotating hub test platform

转毂试验台采用电惯量模拟技术，可以根据汽车道路实验的各种工况，完成汽车实验研究、产品开发、质量检测、经济性实验、动力性实验、排放性能、可靠性实验等专项实验，同时能够检测汽车底盘传动系统有关的损耗功率，以及汽车的油耗、排放等性能测试：

（1）能够完成法规所规定的认证试验循环；

（2）能够模拟行驶阻力；

（3）恒定牵引力；

（4）恒定速度；

（5）能够进行车辆驱动试验；

（6）能够完成耐久性试验；

（7）滑行试验

（8）系统标定

Rotating hub test rig using electric inertia simulation technology which accord to a variety of conditions of vehicle road test, it could complete many special experiment experiments such as automotive experimental research, product development, quality testing, experimental economics, dynamic experiments, emission performance, reliability. At the same time be able to detect the vehicle chassis transmission power loss, and automotive fuel consumption, emissions and other performance tests:

（1） Complete the certification test cycle required by statute.

（2） Simulate driving resistance

（3） Keep traction constant

（4） Keep speed constant

（5） The vehicle drive test can be performed

（6） Complete the durability test

（7） Slide test

（8） System calibration

液力机械自动变速器半实物仿真平台

Semi-physical simulation platform for Hydraulic Automatic Transmission

液力机械自动变速器半实物仿真平台可以实现 AT 电控单元的半实物仿真试验，验证 AT 控制软件，包括换挡逻辑、换档规律和换档过程等的控制逻辑和控制算法；实现多种工况的测试，测试电控单元在不同工况下的功能和性能，可通过模型的设置实现 60%爬坡等危险工况的测试；提供测试过程系统变量的采集，能够采集电磁阀阀芯电磁力、滑阀阀芯位移、离合器主从动件转速等多个实际难以测量的系统变量，用于试验的分析；通过改变系统模型实现不同被控对象的仿真，性能指标如下：

（1）液压系统模型仿真步长为 0.1μs；

（2）机械系统模型仿真步长为 10ms；

（3）使用 CAN 通信进行数据交互，波特率 500kbps。

The semi-physical simulation platform for Hydraulic Automatic Transmission can test the semi-physical simulation of AT electronic control unit, test the AT controlling software, which includes the control logic and control algorithms of the shift logic, shift processes, and the shift schedule. It can test various conditions; test functions and performance of electronic control units in different conditions, and can be set to test other dangerous conditions such as climbing the 60-degree slope.

Performance indicators

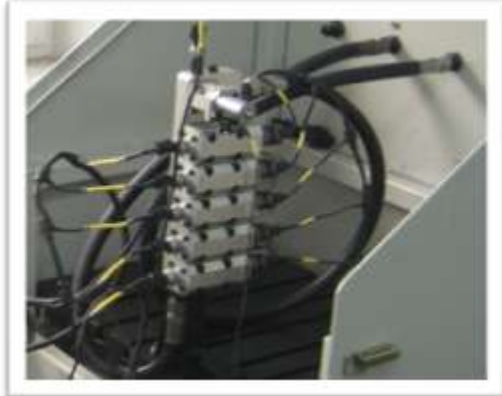
(1) The simulation step of hydraulic system model is 0.1μs.

(2) The simulation step of mechanical system model is 10ms.

(3) The baud rate of the data communication in CAN is 500kbps.

电磁阀性能测试平台

Performance testing platform of solenoid valve




电磁阀性能测试平台主要包括：液压泵站、电磁阀测试台、数据采集仪、示波器等组成。可以测试的性能指标主要有：

（1） 电磁阀的电流特性；
（2） 电磁阀的温度特性；
（3） 电磁阀的电磁力；
（4） 电磁阀的动态响应与电流的关系；
（5） 电磁阀的动态响应与温度的关系。

Solenoid valve performance testing platform mainly includes:pump stations, the solenoid valve test bench, data logger, oscilloscope, etc.Test performance indicators are:

（1） The current characteristic of the solenoid valve;
（2） The temperature characteristics of the solenoid valve;
（3） The electromagnetic force of the solenoid valve;
（4） The relation between current and dynamic response of the solenoid valve;
（5） The relation between temperature and dynamic response of the solenoid valve.

GSE3 高动态换挡机械手测试系统

The testing system of GSE3 high dynamic shift robotic


选换挡机械手执行机构
Shifting robot actuators


离合器机械手系统
Clutch robotic system

主要包括选换档机械手、机械手伺服器、机械手控制器和远程控制器。准确完成换档操纵与测量，通过标定预设点的方式，实现的档位布置形式的确定，档位数目不少与 8 个前进档、4 个倒档和一个空档(可根据变速器的实际档位进行自由布置，通用性好)；

1) 最大选位行程 300mm，最大换档行程 280mm，最大换档速度 1m/s，位置精度 ±0.5mm；
2) 最大换档力动态 500N,静态 300N；
3) 可对档位数、换档模式、换档速度、换档力等进行测量；
4) 具有标准通讯接口。

该机械手测试系统具有三自由度。该系统还备有一个触屏式远程控制器，可通过一个专用网关盒利用 CAN 总线与 GSE3 主控器（控制器）进行通讯。

This system mainly includes shifting robots, robot server, and robot (remote) controllers. Through the calibrating presets, it can accurately complete the shift control and measurement, and determine the gear position, which includes at least 8 forward, 4 backward and 1 neutral, and which can be freely set according to the actual situation.

1) The max selecting stroke is 300mm. The max sifting stroke is 280mm. The max sifting velocity is 1m/s. The location accuracy is ±0.5mm.

2) The dynamic and static sifting powers are separately 500N and 300N.

3) It is testable for the number of gears, shift mode, shift speed, and shift force.

4) It has a standard communication interface.

The robotic testing system has a three-degree freedom. The system also can be manipulated by a remote touch-screen controller through a dedicated gateway box of CAN bus to communicate with GSE3 master.

车辆悬架阻尼试验系统

Vehicle suspension damping test system

主要技术参数：

（1）最大静载荷：50kN；

（2）最大动载荷：30kN；

（3）作动器行程：±150mm；

（4）最大工作流量：200L/min；

（5）最大工作压力：21MPa；

（6）最大功率：95kW；

The main technical parameters:

(1) Maximum static load: 50kN;

(2) Maximum dynamic load: 30kN;

(3) Actuator stroke: ±150mm;

(4) Maximum working flow: 200L/min;

(5) Maximum working pressure: 21MPa;

(6) Maximum power: 95kW

六分力轮力传感器

Six-component wheel force transducers

（1）车辆六分力轮力传感器用于测量汽车实际行驶时由路面作用于轮胎的三垂直力和三个力矩，即轮胎六分力；

（2）由传感器弹性体和信号耦合器组成，弹性体总成通过特殊结构设计串接在轮胎轮辋和车桥轮毂之间，随同车轮一同旋转；耦合器内嵌有车轮转速编码器，不随车轮旋转。

（3）传感器内嵌 MCU 对信号放大、解耦、解算和数据传输；

（4）可应用于：轮胎性能研究与试验、悬架系统开发、ESP 性能与试验；

(1) Vehicles six-component wheel force sensor was applied to measure three vertical forces and three moments, namely tire six-component, acted on the tire by the road when driving cars in reality;

(2) It contented the sensor elastomer and the signal coupler, the elastomer rotated along with the wheels because it is assembled in between the tire rim and the hub axle through special design; The coupler embedded wheel speed encoder, not with the wheels rotation.

(3) Sensors was embedded MCU for signal amplification, decoupling, solver and data transmission;

(4) Can be applied: performance research and experimental on tires, suspension systems development, ESP performance test;

ABS/ASR/ACC 系统研究平台
ABS / ASR / ACC System Research Platform

进行 ABS/ASR/ACC 系统研究的完整软硬件平台，包括：

（1）具备电子控制单元研制所需条件，如电路板制作，评估板，计算机，示波器，信号发生器，稳压电源，模拟器，各种软件等。

（2）具备 ABS/ASR/LDW/FCC 集成安全控制系统硬件系统开发所需条件，如轮速信号传感器，ABS 压力调节器，ASR 压力调节器，电子油门踏板，五轮仪，数据采集装置等。

（3）具备 ABS/ASR/LDW/FCC 集成安全控制系统数字仿真条件，半物理仿真条件，实车试验条件。

（4）车辆 ABS/ASR 综合性能实验台

在充分消化吸收德国申克公司 ABS 性能试验台的基础上，北京理工大学建设了 ABS/ASR 综合性能实验台，用于车辆制动器惯性制动试验、ABS、ASR 和 ABS/ASR 综合性能试验。

（5）各种传感器

车轮扭矩传感器，为国际领先水平的车轮扭矩传感器，可准确实时检测制动过程中地面制动力。

陀螺仪，6 分量微硅陀螺，可准确实时检测车辆行驶过程中车辆的纵向加速度，侧向加速度，法向加速度，翻倾角速度，俯仰角速度，横摆角速度。

五轮仪，测试车辆纵向行驶速度。

（6）快速原型系统开发工具

基于 dSPACE 快速原型系统开发工具，可以进行 ABS/ASR/LDW/FCC 集成安全控制系统控制策略的在线仿真和调试，加快系统开发进度。

（1）dSPACE 是基于 MATLAB/Simulink 的控制系统开发及半实物仿真的软硬件工作平台，实现了和 MATLAB/Simulink/RTW 的完全无缝连接。

（2）拥有实时性强，可靠性高，扩充性好等优点；

（3）处理器具有高速的计算能力，并配备了丰富的 I/O 支持，可以根据需要进行组合；

（4）软件环境的功能强大且使用方便，包括实现代码自动生成/下载和试验/调试的整套工具；

（5）dSPACE 软硬件目前已经成为进行快速控制原型验证和半实物仿真的首选实时平台。

(1)dSPACE is based on MATLAB / Simulink control system development and hardware and software work platform of semi-physical simulation, realized completely seamless connectivity with MATLAB / Simulink / RTW.

(2) Advantages with real-time, high reliability, good scalability;

(3) The processor with high-speed computing power was equipped with a wealth of I / O support, so it coud be combined as needed;

(4) Software environment was powerful and easy to use, including the realization of automatic code generation / download and test / debug tools package;

(5) dSPACE hardware and software has become the first choice platform for rapid control prototyping and semi-physical simulation.

智能车辆研究平台
Intelligent Vehicle Research Platform

1) 轮式履带式环境感知移动平台
Wheeled or Tracked Environment Sensory Moving Platform



2) 机器视觉系统
Machine Vision Systems

3) 激光雷达测距
Laser Radar Ranging




4) 光纤陀螺导航系统
Fiber Optic Gyro Navigation System



5) 惯性导航试验系统
Inertial Navigation Test System



6) 多平台协调控制系统
Multi-Platform Coordinated Control System

重型越野车自动机械变速技术

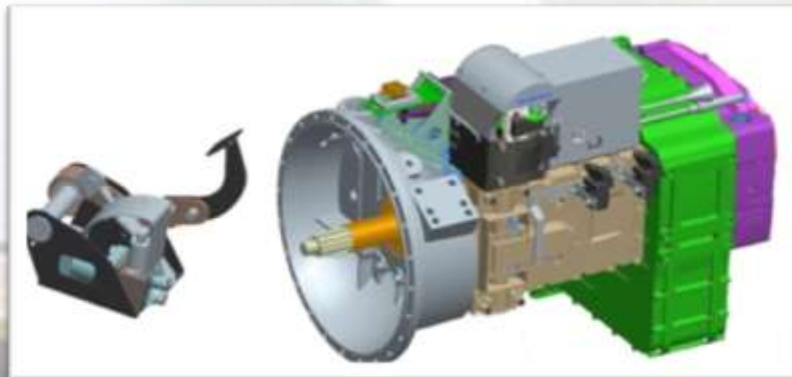
AMT for Heavy off-road vehicles

(1) 手柄式选档器换档控制单元独立油源

Gear selectorShift control unitIndependent oil source

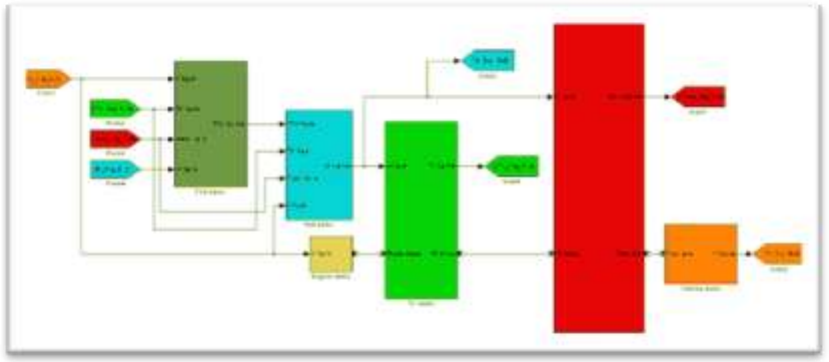
(2) 自动离合执行器自动换挡执行机构

Automatic clutchactuatorAutomatic shift actuator



(3) 自动变速操控系统组成图

Components for the Automatic Transmission Control System



大功率液力机械自动变速器电液控制技术

Electro-hydraulic control technology for Power Hydro -mechanical automatic transmission

大功率液力机械自动变速器电液控制技术开发平台由电子控制器测试试验台、液

压控制回路测试试验台、电液控制系统半实物仿真系统、实车测试系统等组成，能够实现从“用户需求定义、电液系统设计、控制策略优化、系统仿真测试、整车试验标定、故障诊断测试”等相对完整的自动变速器电液控制系统全流程开发。

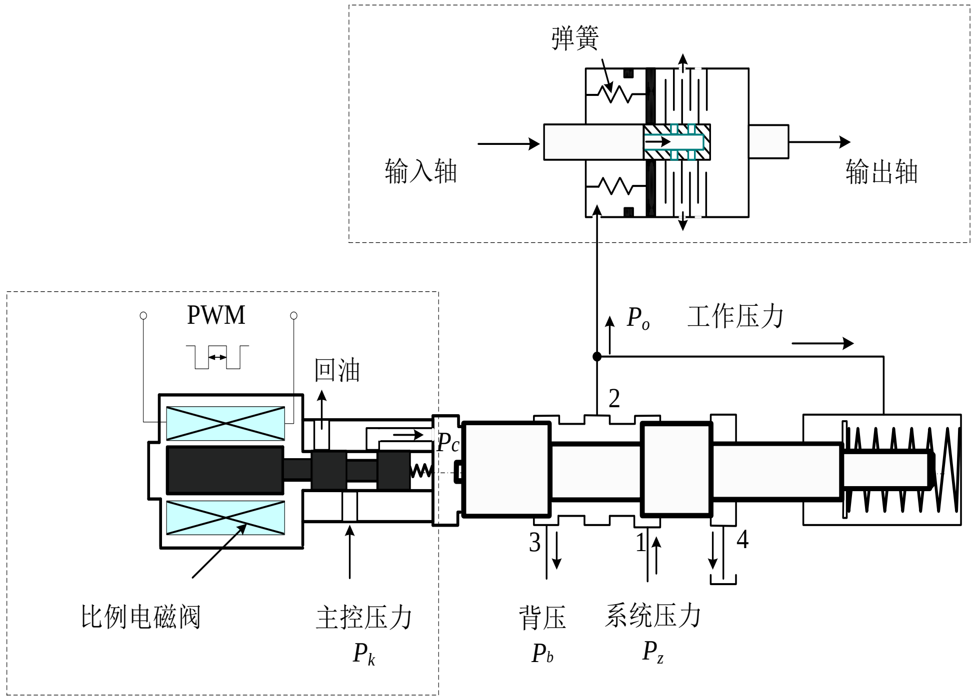
The development platform of Electro-hydraulic control technology for Power Hydro-mechanical automatic transmission consists of Electronic controller test platform, Hydraulic control circuit test platform, Electro-hydraulic control system for semi- physical simulation system and Real vehicle test system, etc. On the platform we could realize the whole developing process of a relatively complete electro-hydraulic control system for an automatic transmission such as “User requirements definition, Electro-hydraulic system design, Control strategy optimization, System Simulation Test, Vehicle test calibration, Fault diagnostic tests, etc.”

1) 电子控制系统设计与试验

Design and test of Electronic Control System

2) 液压控制回路设计与试验

Design and test of Hydraulic Control Circuit

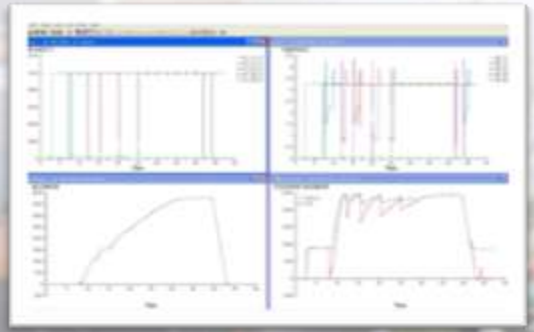


大功率自动变速器采用比例电磁阀和双边节流滑阀构成的换档控制回路实现换档控制。

High-power automatic transmission uses the control circuit, consisting of the proportional solenoid valve and bilateral throttle slide valve, to achieve shifting control.

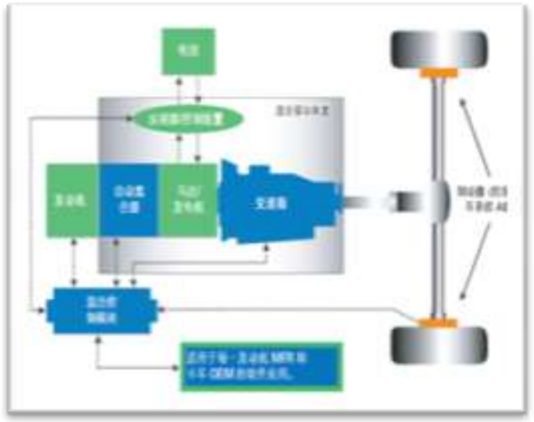
3) 控制策略仿真

Control Strategy Simulation



TCU demo：控制器模型 Hyd demo：液压系统模型 Engine demo：发动机模型
TC demo：变矩器模型 Tans demo：变速器模型 Vehicle demo：车辆模型

新能源汽车自动变速技术
AMT for New energy vehicles



电动客车用 AMT 系统单轴并联混合动力系统（蓝色为自主开发部分）

AMT system for Electric BusSingle-axle parallel hybrid system
（independentdevelopment parts in blue）

为适应新能源车辆（包括纯电动车辆和混合动力车辆）对车辆变速系统的要求，研制了新能源汽车自动变速系统，该系统成功应用于北京奥运会、上海世博会和广州亚运会等纯电动车辆。

Our task force dedicated to design the AMT Systems for Commercial Vehicles, which help to change the condition of the complete-import of such systems. And the independentlydesigned systems were successfully applied in global events such as the Beijing Olympics, and the Shanghai EXPO, etc.

自动变速技术试验平台
Automatic transmission technology experiment platform

自动变速系统关键零部件

1) 电控单元 TCU

Electronic control unit – TCU

大功率液力机械自动变速器 TCU 重型越野车系列自动机械变速器 TCU

纯电动环卫车用自动机械变速器 TCU 纯电动公交车自动机械变速器 TCU

电控单元是车辆自动变速系统的核心部件，在确保实现自动变速基本功能的基础上，要具有故障诊断和在线离线标定功能，同时必须具备良好的电磁兼容性、环境适应性和功能扩展性。目前，已经研制并经过实车考核的电控单元有大功率液力机械自动变速器 TCU、重型越野车系列自动机械变速器 TCU、纯电动公交车用自动机械变速器 TCU 和纯电动城市环卫车用自动机械变速器 TCU。

TCU is the core component of the automatic transmission system, on the basis ofensuring the basic functionsin the automatic transmission, must have the fault diagnosis and online offline calibration function, must also have a good electromagnetic compatibility, environmental adaptability and function extension。Currently，the TCU which has been developed and passed assessment of the real car are as follows, TCU for High–power Hydro-mechanical automatic transmission, TCU for Heavy off-road vehicle series with automatic mechanical transmission, TCU for Pure electric bus with automatic mechanical transmission and TCU for Pure electric city sanitation vehicles with automatic mechanical transmission.

2) 多功能手柄式选档器

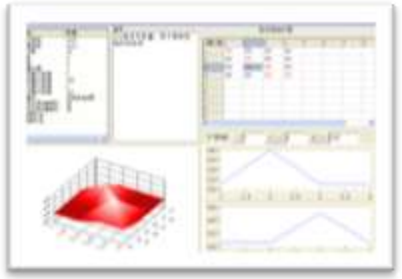
Multi -function gear selector

多功能手柄式选档器，简称换挡手柄，是车辆自动变速系统的主要人机交互接口，将驾驶员对车辆的档位需求信息传输到电控单元 TCU。该换挡手柄可以适应各种装有自动变速系统的车型。

Shift lever, short for Multi -function gear selector lever device,is the main vehicle HCI interfaceof automatic transmission system, which havethe driver’s demand information of the vehicle stalls transmitted to the TCU.Such shift lever can be adapted to a variety of models with automatic transmission system.

3) 故障诊断及标定系统

Fault diagnosis and calibration system



车辆自动变速功能的完美实现必须依托于良好的故障诊断和标定功能。目前已经研制出适应多种的车型的在线、离线故障诊断和在线、离线标定平台。

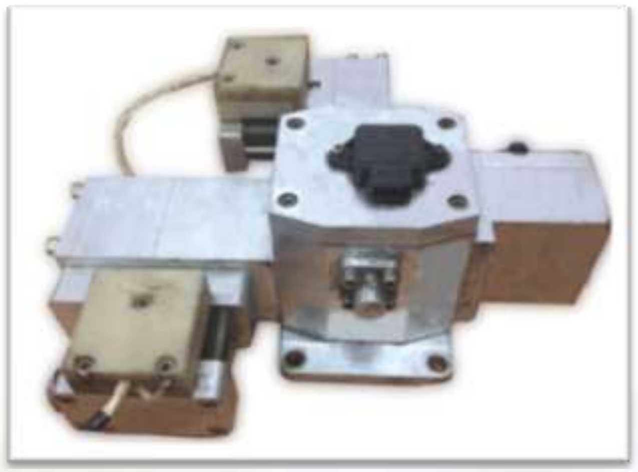
The perfect achievement of vehicle automatic transmission functions must rely on a good Fault diagnosis and calibration system. We have now developed online&offline fault diagnosis and online& offline calibration platforms which can be applied to a variety of models.

4) 自动换挡执行机构

Automatic shift actuator

液动换挡执行机构

Hydraulic shift actuator



气动换挡执行机构

Pneumatic shift actuator

电动换挡执行机构

Electric shift actuators

自动换挡执行机构充分考虑车辆上的空间布置，结构紧凑，系统可靠，针对不同车型，分别设计了电动换挡执行机构、液动换挡执行机构和气动换挡执行机构，同

时可以根据不同车型的需求，进行模块式的搭接。

Automatic shift actuator, fully considered about the spatial arrangement of the vehicle, has the feature of compact, reliability and adaptability to different models. We designed electric shift actuators, hydraulic shift actuator and pneumatic shift actuator, which can belap modularly according to the needs of different models.

集成先进转向、悬架技术的代表性研制样车

1) 越野平台整车总体技术（突击车）

2) 自主乘用车 7082 车身设计

3) 多连杆独立油气悬架技术样车（勇士）

4) 四轮转向样车

5) 空投牵引车

6) 重型高性能越野车可控油气悬架系统

7) 乘用车可控空气悬架系统技术

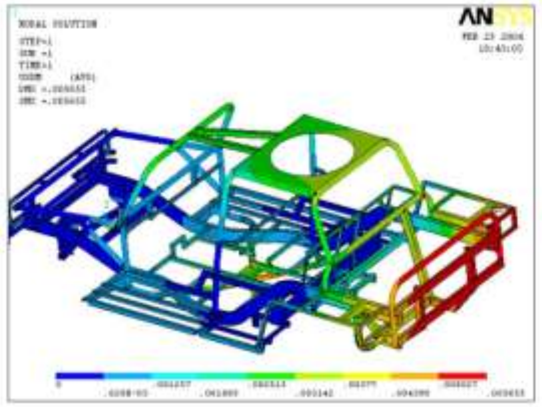
电动全轮转向系统技术

车身技术代表性成果

1) 车辆总体设计理论及技术

图：伞兵突击车 CAD 三维模型

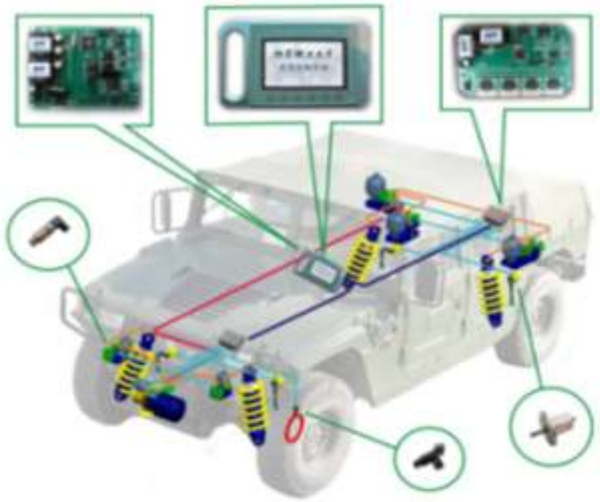
图：自主设计发动机后置四轮驱动系统



图：桁架式承载车身结构　图：空投牵引车虚拟样机模型

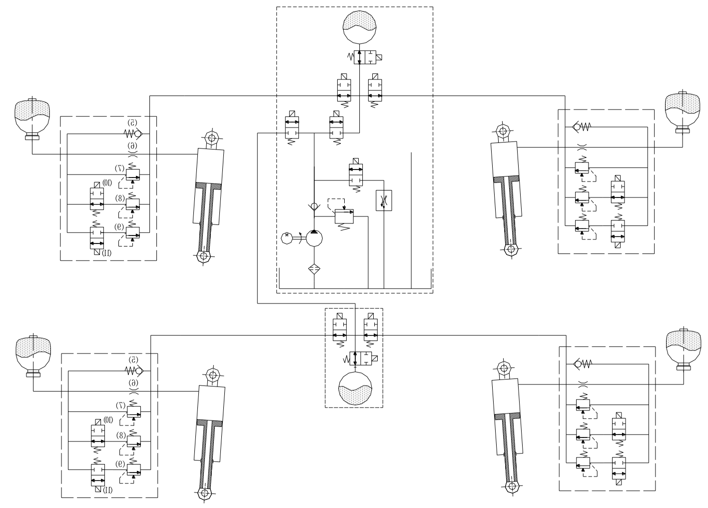
针对汽车总体设计，在汽车总体设计理论、虚拟样机技术、汽车零部件优化设计等科研领域积累了丰富的设计理论和研制经验；

2) 油气悬架系统



图：油气悬架及其智能控制系统

针对轻型/重型越野车悬架系统的理论与科研研究，突破了刚度与阻尼调节的关键技术，实现了悬架系统刚度二级和阻尼三级可控；提出了基于摩擦补偿理论的车高控制算法，实现了车身高度的精确控制；提出了基于智能控制与多传感器信息融合理论的联合控制策略，智能识别与判定行驶工况，实现了车身高度、悬架刚度和阻尼智能控制。设计的公路与越野模式下车身高度、刚度与阻尼不同阈值控制的智能悬架系统，获得国家发明专利 5 项、实用新型专利 3 项

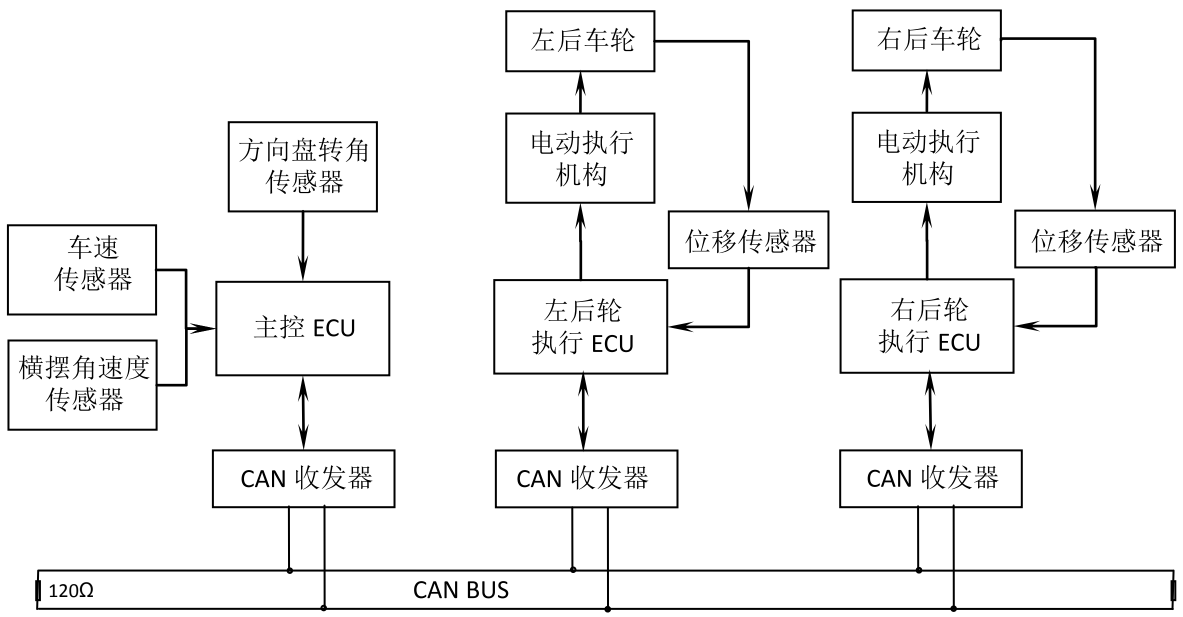


图：油气悬架油缸及液压管路

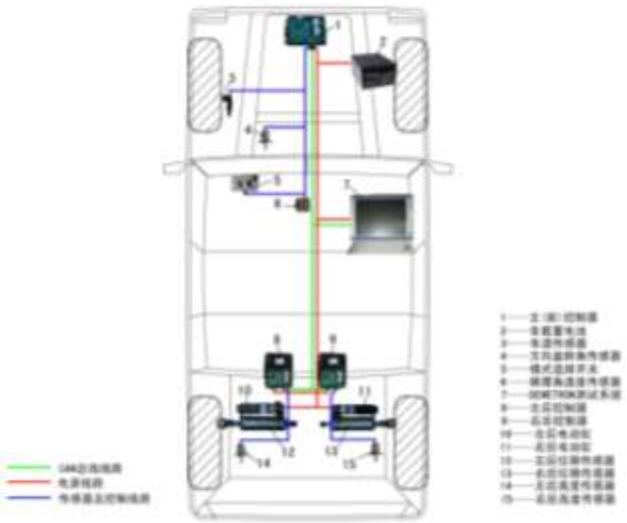
图：油气悬架液压缸及其液压管路

图：阻尼控制阀块

3) 多轮/全轮转向控制系统及理论

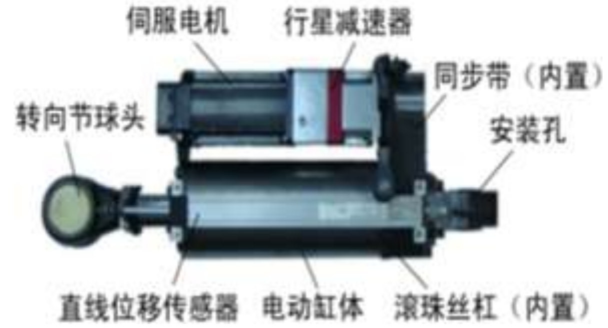


图：电动四轮转向控制系统结构图



图：电动四轮转向控制系统组成

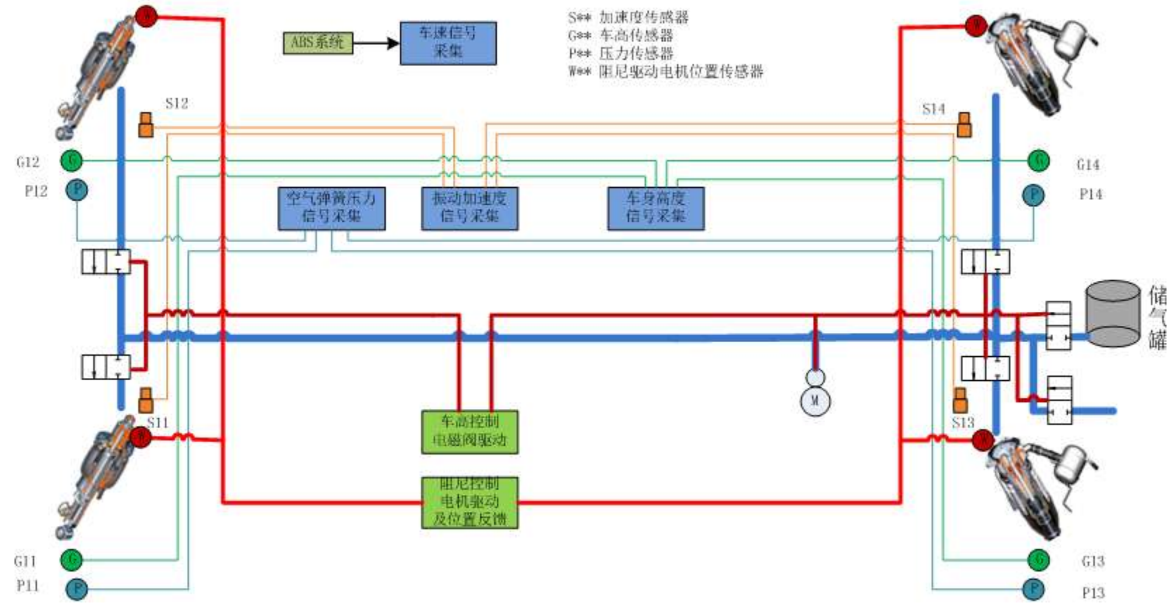
图：电动转向系统 ECU



图：电动转向动力单元

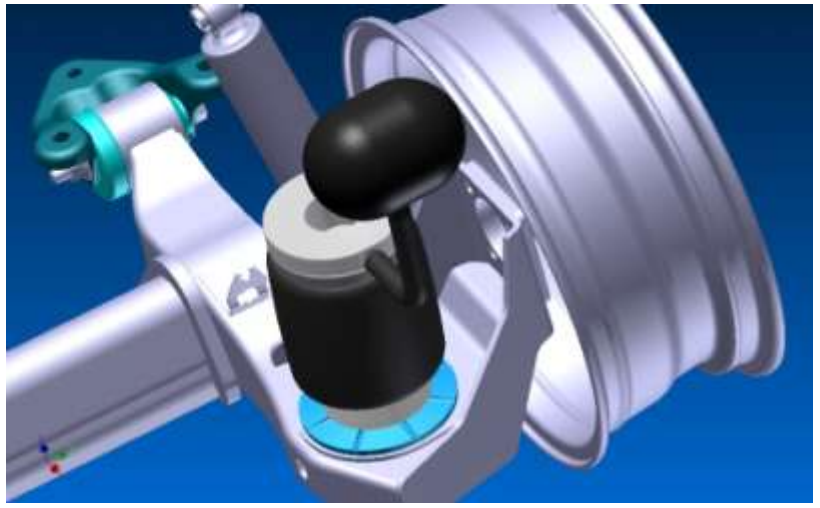
后轮转向采用电动缸作为动力执行元件，根据实际行驶工况分别实现同相位转向和逆相位转向：低速时利用逆相位转向提高车辆的操纵灵活性，高速时利用同相位转向可提高车辆的操纵稳定性。

4) 电控智能空气悬架系统



图：电控智能空气悬架系统组成

图：阻尼可控减振器



图：空气悬架虚拟样机辅助设计

所设计的空气悬架系统，具有（1）车身高度具有四级调节的功能，调整范围不小于 80mm。（2）减振器阻尼具有连续可调功能。（3）弹簧刚度两级可调。（4）提出主动悬架控制策略，可实现根据行驶工况实现“正常” 、“舒适”、“运动”等几种模式的实时切换。

智能车辆技术

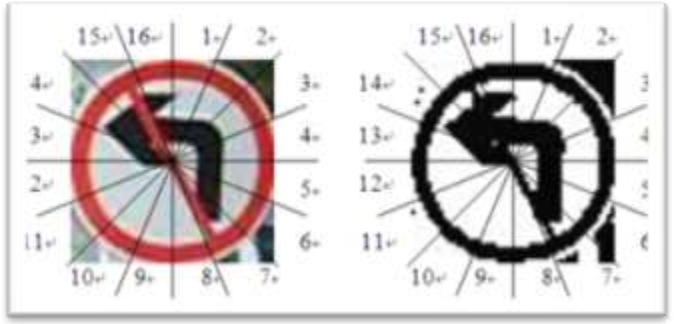
Intelligent Vehicle Technology

1) 车道检测与跟踪

lane detection and following

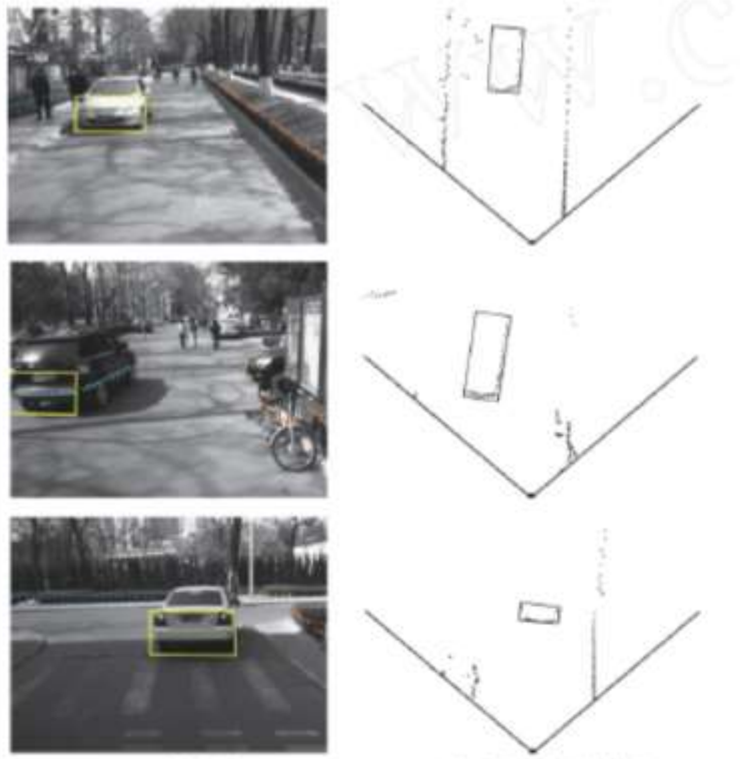
2) 交通标识与交通灯检测

Traffic sign and traffic light detection and recognition



3) 车辆检测

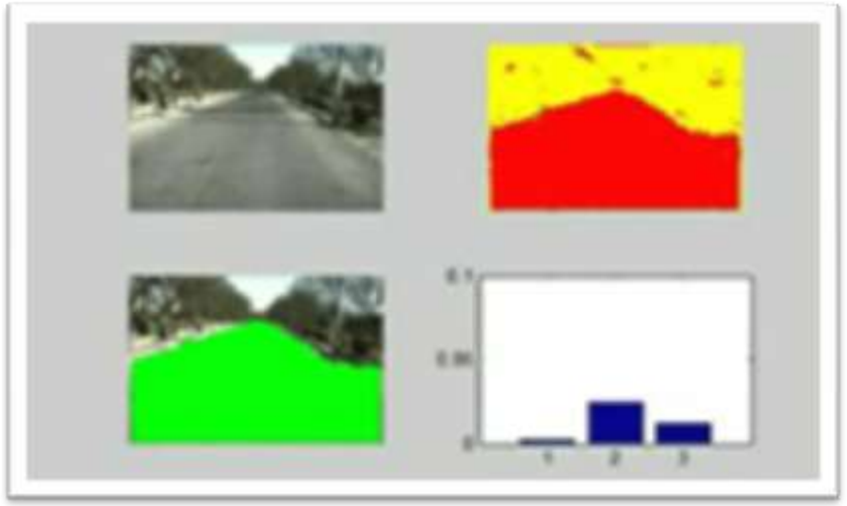
Vehicle detection and recognition



(a) 实物图　　(b) 激光雷达探测结果

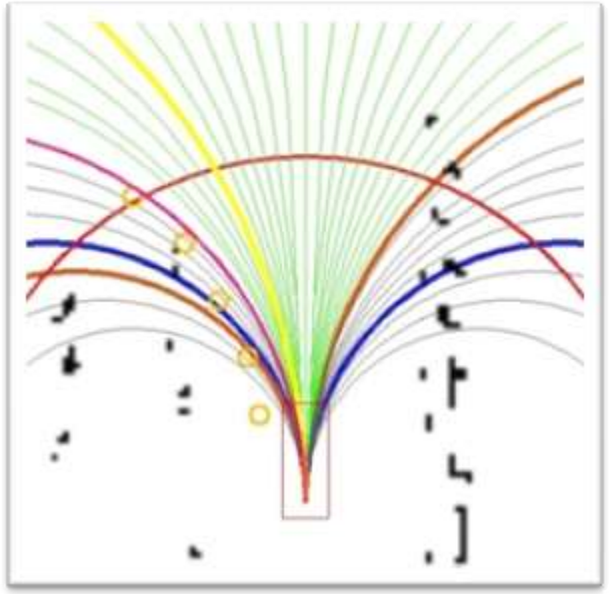
4) 可行驶区域检测与识别

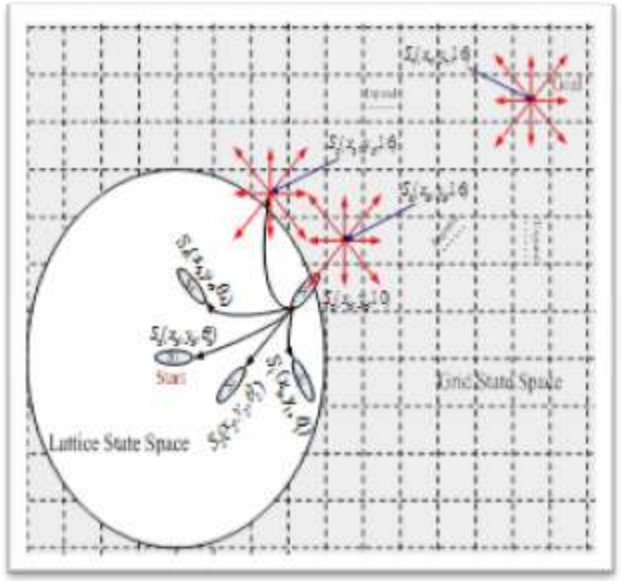
Driverable region detection and recognition

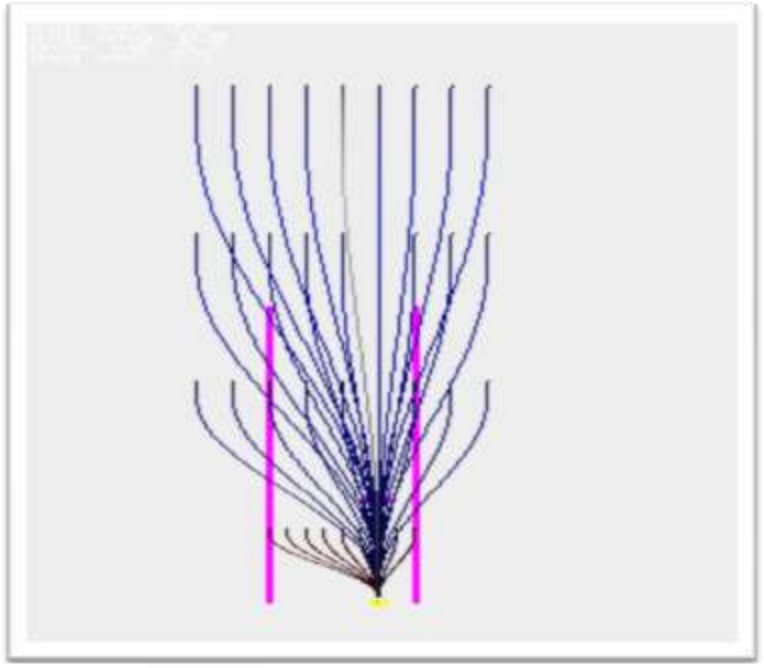


5) 路径规划与跟踪

Path planning and tracking

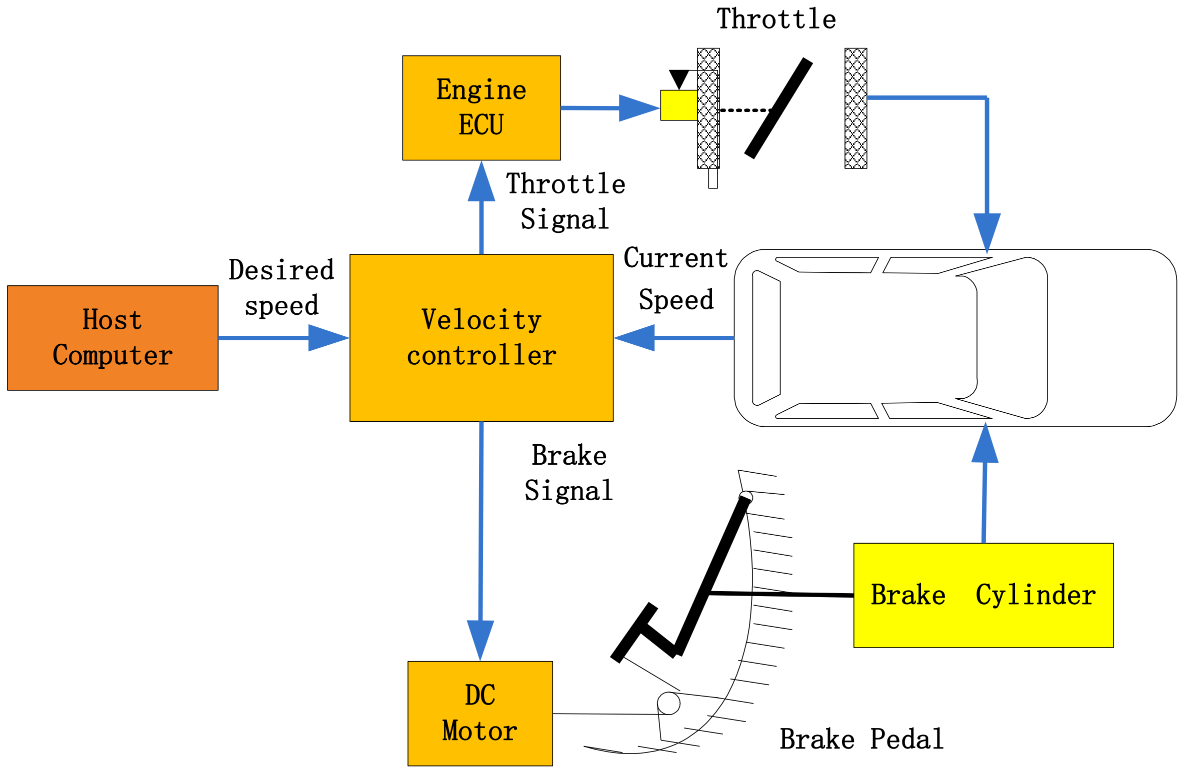






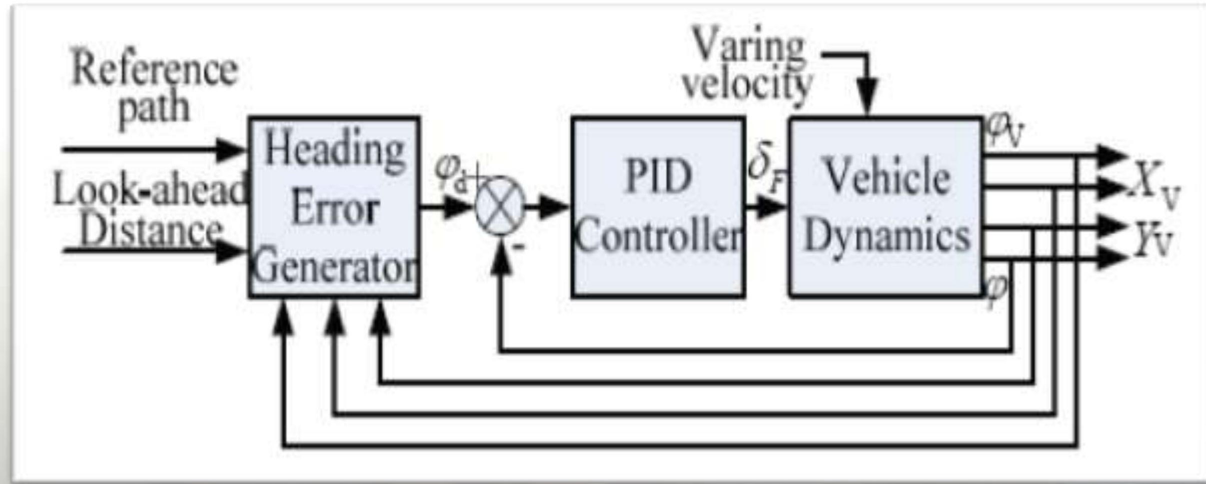
6) 车辆纵向控制

Longitudinal control of vehicles



7) 车辆转向控制

Automatic steering control



汽车安全技术

Automotive Safety Technology

（1）已具有自主知识产权的 ABS 成熟技术，在 ABS 的所有关键技术方面均取得突破，对各种可能的制动工况进行了全方位的实车试验，均表现出良好的控制性能，达到了商品化阶段。

（2）已具有自主知识产权的 ABS/ASR 成熟技术，已进行了大量的对开路面和低附着系数路面 ASR 控制试验，具有良好的性能，使车辆能在对开路面和低附着系数路面上顺利起步和加速。在 ASR 控制模式下，汽车正在加速时，突遇紧急事件需紧急停车时，ASR 能自动退出工作，紧急启动 ABS 控制模式使车辆紧急停车。ABS/ASR 技术达到了商品化水平阶段。

（3）主持制定部级技术标准 6 项，分别于 2007 年和 2008 年颁布实施。

获奖情况 Awards

承担项目 Project

2009 年 6 月，参加国家自科学基金委“视听觉信息的认知计算”重大研究计划首届中国“智能车未来挑战赛”，获亚军与“最佳环境感知奖”

The 2009 Future Challenge: Intelligent Vehicles and Beyond (FC’09) was held in Xi’an, China ,June 4-5,2009.Our intelligent vehicle BIT won the 2nd place and “Environment Perception “ Best technology Award

证书 Certificate

国际合作 International Cooperation

2011 年 12 月，实验室老师对美国 MIT、CMU 进行学术访问。

2011 年 8 月，荷兰代尔夫特理工大学 4 名硕士研究生访问实验室

2011 年 2 月，法国贡比涅技术大学(Université de Technologie de Compiègne) Philippe BONNIFAIT 教授一行 6 人访问实验室