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| **关于实验室** | **科研创新** | **平台建设** | **新闻与媒体** | **开放交流** | **荣誉成果** | **人才培养** | **联系我们** |
| 实验室简介 | 研究方向 | 大数据中心 | 实验室要闻 | 开放课题 | 总说 | 招聘动态 |  |
| 主任致辞 | 院士寄语 | 刀盘刀具技术 | 行业动态 | 学术会议 | 成果一 | 人才办法 |  |
| 理事会 | 学术带头人 | 系统集成及控制 | 通知公告 | 合作交流 | 成果二 | 技术培训 |  |
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1. **关于实验室**

**1.实验室简介**

盾构及掘进技术国家重点实验室（以下简称“实验室”）以中铁隧道局集团为依托，以重大装备及重点工程为载体，联合国内外相关企业、大学和研究机构，开展盾构TBM行业应用基础与前沿、共性、关键技术研究，形成具有核心关键技术与自主知识产权的盾构制造和施工成套技术，为国家盾构行业提供强有力的技术支撑和服务。在此基础上，打造技术创新、人才培养、学术交流、培训教育基地，实现我国重大装备和施工技术的持续创新突破。

实验室于2010年1月6日由科技部批准建设，2010年9月21日通过可行性论证，2012年4月26日建成揭牌，2012年11月22日通过科技部建设验收，是国家第二批企业国家重点实验室中首家建成、首家通过建设验收的国家重点实验室，是盾构及掘进技术领域唯一的国家公共研究平台。实验室于2017年12月通过科技部首次五年评估，获评为优秀类企业国家重点实验室。

实验室创建了以学术委员会为指导、以实验室主任为学术带头人，以盾构及掘进技术领域优秀人才为主体的创新团队，拥有河南省盾构及掘进技术国际联合实验室、河南省地下工程技术与装备创新团队、水利与交通基础设施安全防护河南省协同创新中心、机械装备先进制造河南省协同创新中心、科技部重点领域创新团队——盾构及掘进技术创新团队、中国工程机械学会全断面隧道掘进机技术培训与技能鉴定站。

实验室凝练了刀盘刀具技术、系统集成与控制、盾构施工控制等三大研究方向，自主研发了国际先进的盾构TBM工程大数据平台、TBM掘进模态综合实验平台、滚刀岩机作用综合实验平台等十五大综合实验系统。实验室通过开展盾构TBM大数据技术研究，研发了集工程地质、施工环境、隧道结构、装备状态等多数据于一体的盾构TBM工程大数据应用中心，实现了智能监控、协同管理、综合分析、风险预警、决策辅助等功能；通过依托汕头苏埃海底隧道、高黎贡山铁路隧道、深圳春风隧道等重大工程，开展自主选题进行应用基础研究和重大基础前沿关键技术研究，攻克了刀盘刀具适应性选型、复杂地质条件整机适应性、异形盾构及TBM研制、超大直径盾构施工、水下复杂地质条件、软硬不均和城区富水砂卵石地层等诸多不良地质盾构TBM隧道修建关键技术，实现了盾构TBM关键部件及控制系统的高可靠性开发，促使了我国首台TBM、首台马蹄形盾构、最大的矩形掘进机、国内最大直径盾构（15.8m）等重大装备的自主研制，推动了我国盾构TBM技术的创新发展。

截止2018年底，实验室承担各类科研项目74项（其中，国家级科研项目12项），获地市级以上科技成果奖励60余项（其中，国家科技进步一等奖1项、二等奖4项，省部级科技进步一等奖15项、二等奖21项、三等奖12项），获国家发明专利59项、实用新型专利31项、软件著作权18项，制修订国家标准13项、行业标准15项，出版专著9部，发表学术论文500余篇（SCI/EI检索36篇），已成为国家盾构及掘进技术领域的科研创新基地、学术交流基地、人才培养基地和教育培训基地。

实验室实行“开放、流动、联合、竞争”的运行机制，秉承“求真无畏、进取不止”的学术理念，与相关高等院校、科研院所及企业建立产学研用联盟，共同致力于中国盾构TBM行业技术的整体进步与提高，为建设创新型国家、科技强国、交通强国、智慧社会而不懈奋斗，为实现中华民族伟大复兴的中国梦谱写新篇章！

**Brief Introduction**

Following the leadership of the board and the instruction of the academic committee, SKLST (State Key Laboratory of Shield Machine and Boring Technology) adopts the laboratory director responsible system under the management of CRTG (China Railway Tunnel Group Co., Ltd.) and the assistant management of CREG (China Railway Engineering Equipment Group Co., Ltd.). Financially and administratively supported by CRTG, SKLST is among the second batch of the state key laboratories authorized by the MOST. Awarded the titles of “Henan International Joint Laboratory of Shield Machine & Boring Technology”, “Henan Underground Engineering Equipment Innovation Team”, “Henan Innovation Center of Safety Protection for Communication & Water Conservancy Infrastructure”, “Henan Innovation Center of Advanced Machinery Equipment Manufacture” and “Innovation Team of Shield Machine & Boring Technology” by the MOST, SKLST serves as the sole national public platform in the field of shield machine and boring technology. The gross area of SKLST is 13,000 m2, and the total investment on SKLST 120 million RMB. The construction plan demonstration of SKLST was approved on Jan. 6th, 2010, and so was its feasibility demonstration of construction plan on Sept. 21st, 2012. SKLST opening ceremony took place on Apr. 26th, 2012, and passed the check before acceptance by the MOST on Nov. 22nd. In Dec. 2017, it passed the first 5-year evaluation by the MOST and was ranked among the excellent ones.

Complying with the operation mechanism of "open, flexible, united, competitive" and the academic spirit of "seek truth and forge ahead", SKLST boasts its best scientific research condition. With its three research directions, namely, cutter-head & cutting tools, system integration & control and shield construction control, it builds 15 experimental systems. By the end of 2018, SKLST has been awarded 60 prizes municipal-level and above (including 1 first-grade national prize, 4 second-grade national prizes and other 48 provincial-level prizes). In addition, SKLST has obtained 59 invention patents, 31 utility patents and 18 software copyrights. Over 500 papers (36 in SCI/EI periodicals) and 9 scholarly books written by SKLST have been published. Over 20 standards have been applied.

1. **主任致辞**

2014年，国家主席习近平在河南考察时，强调要“推动中国制造向中国创造转变、中国速度向中国质量转变、中国产品向中国品牌转变”，为打造中国品牌、推动产业结构转型升级、建设创新型国家指明了方向。

盾构及掘进技术国家重点实验室牢记总书记“三个转变”重要思想，以梦为马、风雨兼程，持续完善科技创新机制，加快人才团队建设，拓展产学研用联盟，促进科研成果转化，创新能力大幅提升，科研实力显著增强，取得了令人瞩目的成绩。实验室通过开展盾构TBM大数据技术研究，研发了集工程地质、施工环境、隧道结构、装备状态等多数据于一体的盾构TBM工程大数据应用中心，实现了智能监控、协同管理、综合分析、风险预警、决策辅助等功能；通过依托汕头苏埃海湾隧道、高黎贡山铁路隧道、深圳春风隧道等重大工程，开展自主选题应用基础研究和重大基础前沿关键技术研究，攻克了刀盘刀具适应性选型、复杂地质条件整机适应性、异形盾构及TBM研制、超大直径盾构施工、水下复杂地质条件和城区富水砂卵石地层隧道修建等关键技术，实现了盾构TBM关键部件及控制系统的高可靠性开发，促使了我国首台TBM、首台马蹄形盾构、最大的矩形掘进机、国内最大直径盾构(15.8m)等重大装备的自主研制，推动了我国盾构TBM技术的创新发展。2017年底，在科技部的首次运行评估中，实验室顺利通过评估，获评为优秀类企业国家重点实验室。

栉风沐雨几多载，砥砺奋进续华章。未来，实验室将以十九大精神为指引，瞄准国际盾构及掘进技术发展前沿，强化基础理论研究与工程实践，积极承担国家重大科技项目，努力实现关键性技术、前沿引领技术、颠覆性技术创新，为建设创新型国家、科技强国、质量强国、交通强国、数字中国、智慧社会而不懈奋斗，为实现中华民族伟大复兴的中国梦谱写更加壮丽的新篇章。

Director’s Speech

Chinese President Xi Jinping, during his visit to Henan Province in 2014, made a point of the three transformations of China, namely, the transformation from “Made in China”to“Created in China”, from“China speed”to “China quality”and from“Chinese products”to “Chinese brands”, which lights up a path for promoting the Chinese brands to the world class, upgrading China’s industry and transforming China into an innovative country.

Keeping that in mind, we carried on our technological innovation, talent training and interdisciplinary collaboration, and accelerated transforming our research achievements into productivity. After years of hard work, we significantly elevated our innovation ability and yielded remarkable results. By studying big-data technology, we developed TBM Big-Data Construction Center, which realizes the functions of data collection, collaborative management, comprehensive analysis, risk warning and decision-making aid by collecting and analyzing data at real time that reflect geological condition, construction environment, tunnel structure, TBM operation and other construction information. Based on Su-Ai Undersea Tunnel, Mount Gaoligong Tunnel, Chunfeng Tunnel and other large projects, we conducted applied basic researches and frontier key researches, and conquered the technologies for cutter-head design, geological adaptability expansion, special-shaped TBM development, super-diameter TBM construction, TBM tunneling in complex underwater strata and in urban water-rich gravel strata, etc. Those pushed forward the development of domestic TBM components and control systems, which, in return, precipitated the advents of China’s first independently-developed hard-rock TBM, the first horseshoe-shaped TBM, the largest rectangular TBM and other major equipment. In Dec. 2017, we passed the first 5-year evaluation by the MOST (the Ministry of Science & Technology of China), and was ranked among the excellent ones.

**3.理事会**

理事长 刘辉

**理事长单位：**

中国中铁股份有限公司

**副理事长单位：**

中铁隧道局集团有限公司

中铁工程装备集团有限公司

理事单位：

中铁二院工程集团有限责任公司

中铁第六勘察设计院集团有限公司

中铁科学研究院有限公司

中铁南方投资集团有限公司

中铁投资集团有限公司

中铁开发投资集团有限公司

中铁城市发展投资集团有限公司

中铁科工集团有限公司

中铁一局集团有限公司

Board of Directors

President:

Liu Hui, China Railway Group Co., Ltd.

President Company:

China Railway Group Co., Ltd.

Vice-President Companies:

China Railway Tunnel Group Co., Ltd.

China Railway Engineering Equipment Group Co., Ltd.

Director Companies:

China Railway Eryuan Engineering Group Co., Ltd.

China Railway Liuyuan Group Co., Ltd.

China Railway Academy Co., Ltd.

China Railway South Investment Group Co., Ltd.

China Railway Investment Group Co., Ltd.

China Railway Development & Investment Group Co., Ltd.

China Railway City Development & Investment Group Co., Ltd.

China Railway Science & Industry Group Co., Ltd.

China Railway First Group Co., Ltd.

**4.领导关怀 （以照片为主）**

1. 国家主席习近平视察实验室成果转化基地

2. 全国人大常委会副委员长、中华全国总工会主席王兆国亲切接见实验室主任洪开荣

3. 科学技术部副部长陈小娅视察实验室

4. 原河南省省委书记谢伏瞻视察实验室

5. 河南省省长陈润儿视察实验室

**二、研究方向**

**1.总说**

实验室凝练了刀盘刀具技术、系统集成与控制、盾构施工控制三个研究方向，面向国家战略需求和学科发展前沿，立足盾构及掘进技术研究，解决盾构自主设计的前沿技术、共性技术和关键技术，促进盾构装备制造业和盾构施工技术的发展。

Research Directions of SKLST

SKLST sets three research directions, namely, cutter-head & cutting tools, system integration & control and shield construction control. Oriented by national developing strategy and scientific frontier, based on the researches in shield machine and boring technology, SKLST endeavors to explore the frontier technologies, common technologies and key technologies needed by domestic design of shield machine to accelerate the development of shield equipment manufacturing and construction.

**1.1刀盘刀具技术**

以岩机相互作用机理研究为基础，着力研究典型地质的刀盘刀具材料、结构与磨损规律，重点突破刀盘刀具地质适应性关键技术。

研究重点：

◆刀盘刀具高效破岩基础理论 ◆盾构数字化掘进前沿技术

◆刀盘刀具磨蚀机理 ◆超大直径盾构适应性设计技术

◆异形盾构刀盘全断面切削系统

Cutter-Head & Cutting Tools

Based on researches on the mechanism of rock fragmentation, SKLST concentrates on the materials, structures and wearing mechanisms of cutter-head and cutting tools in typical geological conditions, aiming at enhancing geological adaptability of cutter-head and cutting tools.

Research Focus:

◇High-Efficiency rock-breaking theories for cutter-head and cutting tools

◇Digital technologies for shield excavation

◇Abrasion mechanism of cutter-head and cutting tools

◇Adaptability design of super-diameter shield machine

◇Full-Face excavation system for special-shaped shield machine

**1.2系统集成与控制**

以自动化控制技术、大数据分析应用技术和系统集成理论研究为基础，以面向盾构TBM装备自控系统集成及掘进技术智能控制研究为导向，重点促进盾构TBM主轴承、刀具轴承、减速箱、液压泵等关键部件国产化开发，突破盾构TBM智能化掘进及整机系统集成创新关键技术。

研究重点

◆刀盘刀具高效破岩基础理论 ◆盾构数字化掘进前沿技术

◆刀盘刀具磨蚀机理 ◆超大直径盾构适应性设计技术

◆异形盾构刀盘全断面切削系统

System Integration & Control

Based on researches on automatic control, big-data analysis & application and system integration, SKLST concentrates on the nationalization of core parts of shield machine such as main bearings, cutter bearings, reduction boxes, hydraulic pumps and so on, aiming at breakthroughs in the key technologies for key component manufacturing, intelligent control and system integration of shield machine.

Research Focuses:

◇General basic researches on shield electro-hydraulic system

◇Innovation and design of shield key components

◇System integration and control for TBM construction in complex geologies

**1.3盾构施工控制**

以盾构施工力学特性与隧道结构分析研究为基础，着力研究典型地质的盾构施工安全控制及围岩稳定控制技术、结构安全风险评估技术，重点突破软硬不均等复合地层盾构掘进控制与管理关键技术。

盾构施工控制研究重点

◆盾构TBM施工共性问题及围岩场重构理论

◆软硬不均地层盾构掘进关键应用技术

◆超大断面土压平衡顶管综合施工技术

Shield Construction Control

Based on researches on the mechanical property of shield construction as well as structural analysis of tunnels, SKLST concentrates on the safety control of shield construction, stability control of surrounding rock and risk assessment of structural safety, aiming at the key technologies for shield construction control and management in soft-hard interlaying strata.

Research Focuses:

◇General issues and rock-strata reconstruction theories for TBM construction

◇Key technologies for shield construction in soft-hard interlaying strata

◇Comprehensive technologies for large-face EPB pipe-jacking construction

**2.学术委员会**

主任：

钱七虎　中国工程院院士、军委科技委顾问、教授

委员：

王梦恕　中国工程院院士、教授级高工

杨华勇　中国工程院院士、浙江大学教授

杜彦良　中国工程院院士、石家庄铁道大学教授

王复明　中国工程院院士、郑州大学教授

陈湘生　中国工程院院士、深圳地铁公司总工程师、教授级高工

刘　辉　中国中铁股份有限公司副总裁、教授级高工

周振国　中国中铁股份有限公司副总工程师、教授级高工

黄　田 　天津大学教授

何　川　西南交通大学教授

洪开荣 　中铁隧道局集团有限公司总工程师、教授级高工

韩亚丽 　中铁工程装备集团有限公司巡视员、教授级高工

孙振川　盾构及掘进技术国家重点实验室执行主任、教授级高工

**Academic Committee**

**Chairman:**

Qian Qihu, Academician, Ministry of Defense of China.

**Committee members:**

Wang Mengshu, Academician, China Railway Group Co., Ltd.

Yang Huayong, Academician, Zhejiang University

Du Yanliang, Academician, Shijiazhuang Tiedao University

Wang Fuming, Academician, Zhengzhou University

Chen Xiangsheng, Academician, Shenzhen Metro Group Co., Ltd.

Liu Hui, Professorate Senior Engineer, China Railway Group Co., Ltd.

Zhou Zhenguo, Professorate Senior Engineer, China Railway Group Co., Ltd.

Huang Tian, Professor, Tianjin University

He Chuan, Professor, Southwest Jiaotong University

Hong Kairong, Professorate Senior Engineer, China Railway Tunnel Group Co., Ltd.

Han Yali, Professorate Senior Engineer, China Railway Engineering Equipment Group Co., Ltd.

Sun Zhenchuan, Professorate Senior Engineer, China Railway Tunnel Group Co., Ltd.

**3.院士寄语**

中国工程院院士钱七虎题词

中国工程院院士何华武题词

中国工程院院士杨华勇题词

中国工程院院士杜彦良题词

中国工程院院士王复明题词

中国工程院院士陈湘生题词

Academician’s words:

Qian Qihu, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

He Huawu, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

Yang Huayong, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

Du Yanliang, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

Wang Fuming, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

Chen Xiangsheng, the academician of Chinese Academy of Engineering, is writing an inscription for SKLST.

1. **学术带头人**

**洪开荣**1965年生，教授级高工，博士生导师，中国中铁专家，中铁隧道局集团总工程师、盾构及掘进技术国家重点实验室主任，享受国务院政府特殊津贴，主要从事隧道及地下工程领域研究；获发明专利34项、国家级工法2项，省部级工法10项；获国家科技进步一等奖1项、二等奖2项，河南省科技进步一等奖4项，第七届詹天佑铁道科技大奖青年奖，第九届詹天佑铁道科技大奖成就奖，第十三届詹天佑铁道科学技术大奖，中国铁路工程总公司科学技术特等奖2项；先后荣获全国劳动模范、全国五一劳动奖章、中原学者等称号；入选百千万人才工程国家级人选、人社部有突出贡献中青年专家、国家高层次人才特殊支持计划领军人才；兼任中国土木工程学会隧道及地下工程分会秘书长。

Hong Kairong born in 1965, PhD supervisor, professorate senior engineer, CREC expert, national special allowance recipient, chief engineer of CRTG, director of SKLST, specializes in tunneling & underground engineering. Having obtained 34 invention patents, created 2 national and 10 provincial-level construction methods, he has received 1 first-grade and 2 second-grade Prizes for National Science & Technology Progress, 4 first-grade Prizes for Henan Science & Technology Progress, the Seventh Youth Prize of Zhan Tianyou Railway Technology, the Ninth Achievement Prize of Zhan Tianyou Railway Technology, 2 special-grade Prizes for CREC Science & Technology Progress. He has received many honors such as National Labor Model, National May 1st Labor Medalist, Zhongyuan Scholar, member of National Talent Team Project, National Outstanding Contributor, etc. He is also the secretary of Tunnel & Underground Works Branch of China Civil Engineering Society.

**康宝生**　1959年生，教授级高工，中国中铁专家，中铁隧道局集团副总工程师，主要从事盾构及掘进技术研究；主持和参与多项国家及省部级重点科研项目；获发明专利5项、实用新型专利8项、外观专利3项；获河南省科技进步二等奖2项，中国施工企业管理协会科学技术奖技术创新成果一等奖1项，中国铁路工程总公司科学技术特等奖1项、一等奖1项、二等奖2项，洛阳市科技进步一等奖3项；兼任中国工程机械工业协会施工机械化分会理事及施工机械化分会的中国工程机械技术专家、中国土木工程学会隧道及地下工程分会隧道掘进机（盾构TBM）专业委员会委员。

Kang Baosheng born in 1959, professorate senior engineer, CREC expert, deputy chief engineer of CRTG, specializes in shield and boring technology. He has presided over and participated in a number of important research projects provincial-level and above. He has obtained 2 invention patents, 5 utility model patents, 3 appearance patents and published 16 papers. He has been awarded 2 second-grade Prizes for Henan Science & Technology Progress, 1 first-grade Prize of China Association of Construction Enterprise Management, 1 special-grade, 1 first-grade and 2 second-grade Prizes for CREC Science & Technology Progress, 3 first-grade Prizes for Luoyang Science & Technology Progress. He is also the board member and mechanical expert of Construction Machinery Branch of China Construction Machinery Association, member of TBM committee of Tunnel & Underground Works Branch of China Civil Engineering Society.

**卓　越**　1965年生，博士生导师，教授级高工，中国中铁专家，中铁隧道局集团副总工程师，享受国务院政府特殊津贴，从事隧道及地下工程领域研究；获发明专利5项、实用新型专利8项、外观设计专利4项、国家级工法1项；获国家科技进步二等奖1项，河南省科技进步二等奖1项，重庆市科学技术二等奖1项，中国铁路工程总公司科学技术特等奖2项、一等奖1项、三等奖1项，中国铁道学会科学技术特等奖1项、二等奖1项、三等奖1项，中国施工企业管理协会科学技术一等奖2项、二等奖1项。

Zhuo Yue born in 1965, PhD supervisor, professorate senior engineer, CREC expert, deputy chief engineer of CRTG, national special allowance recipient, specializes in tunneling & underground engineering. He has obtained 5 invention patents, 8 utility model patents, 4 appearance patents and 1 national construction method. He has been awarded 1 second-grade Prize for National Science & Technology Progress, 1 second-grade Prize for Henan Science & Technology Progress, 1 second-grade Prize for Chongqing Science & Technology Progress, 2 special-grade, 1 first-grade and 1 third-grade Prizes for CREC Science & Technology Progress, 1 special-grade, 1 second-grade and 1 third-grade prizes of China Railway Society, 2 first-grade and 1 second-grade prizes of China Association of Construction Enterprise Management.

**陈　馈**　1963年生，教授级高工，中国中铁专家，中铁隧道局集团一级专家，盾构及掘进技术国家重点实验室党工委书记、常务副主任，享受国务院政府特殊津贴，主要从事盾构及掘进技术研究；主持国家863计划项目2项、国家973计划项目2项，参与国家863计划项目6项；主持编写国家行业标准2项；获发明专利15项；在国内外核心学术期刊发表论文130余篇，出版专著5部；获国家科技进步一等奖1项，河南省科技进步一等奖1项，中国铁路工程总公司科学技术特等奖1项、一等奖5项；兼任航空精密轴承国家重点实验室、高端工程机械智能制造国家重点实验室学术委员会委员。

Chen Kui born in 1963, professorate senior engineer, CREC expert, first-class expert of CRTG, national special allowance recipient, party chief and standing deputy director of SKLST, specializes in shield machine and boring technology. Having presided over 2 National 863 Plan Projects, 2 National 973 Plan Projects and participated in 6 National 863 Plan Projects, he has created 2 national industrial standards, obtained 15 invention patents, published 5 books and more than 130 papers. His outstanding achievements has won him 1 first-grade Prize for National Science & Technology Progress, 1 first-grade Prize for Henan Science & Technology Progress, 1 special-grade and 5 first-grade Prizes for CREC Science & Technology Progress. Moreover, he is the academic committee member of State Key Laboratory of Aerospace Bearing and that of State Key Laboratory of Hi-End Intelligent Manufacturing.

**王杜娟**　1978年生，教授级高工，第十三届全国人大代表，中铁工程装备集团总工程师，盾构及掘进技术国家重点实验室常务副主任，长期从事隧道掘进装备的研发；参加国家863计划项目4项、国家重点研发计划专项1项、铁道部重大课题1项；获发明专利22项、实用新型专利31项；获国家科技进步二等奖1项，河南省科技进步一等奖2项、二等奖1项，中国铁路工程总公司科学技术特等奖2项、一等奖8项，詹天佑基金会詹天佑青年奖，茅以升铁道科学技术奖——铁道工程师奖；获全国最美十大科技工作者、全国五一巾帼标兵、全国铁路先进女职工、中华全国铁路总工会火车头奖章、河南省学术技术带头人、中国中铁十大杰出青年等荣誉称号。

Wang Dujuan　born in 1978, professorate senior engineer, deputy of 13th NPC, chief engineer of CREG, standing deputy director of SKLST, specializes in tunneling equipment R&D. She has participated in 4 National 863 Plan Projects, 1 National Key R&D Program, and obtained 22 invention patents and 31 utility model patents. She has been awarded 1 second-grade Prizes for National Science & Technology Progress, 2 first-grade and 1 second-grade Prizes for Henan Science & Technology Progress, 2 special-grade and 8 first-grade Prizes for CREC Science & Technology Progress, the Youth Prize of Zhan Tianyou Railway Technology, the Engineer Prize of Mao Yisheng Railway Technology. She also won the honors such as National Most Beautiful Scientific Researcher, National Female Labor Model, National Advanced Female Worker, Locomotive Medalist of China Railway Labor Union, etc.

**孙振川**　1972年生，教授级高工，中国中铁专家，盾构及掘进技术国家重点实验室执行主任，享受国务院政府特殊津贴；主持国家级课题1项、省部级课题多项；获发明专利26项、实用新型专利12项；编写省部级工法5项；出版专著3部；获国家科技进步二等奖1项，河南省科技进步一等奖3项，福建省科技进步二等奖1项，中国铁路工程总公司科学技术特等奖3项、一等奖4项、二等奖2项，中国施工企业管理协会科学技术一等奖3项，施工企业管理协会科学技术创新成果特等奖1项，中国公路学会科学技术一等奖1项，中国中铁青年创新奖一等奖1项；获河南省学术技术带头人、福建省劳动模范、厦门市五一劳动奖章、中国施工企业管理协会科技创新先进个人等荣誉；兼任住建部绿色专家委员会委员、中国爆破行业专家库专家等。

Sun Zhenchuan born in 1972, professorate senior engineer, CREC expert, executive director of SKLST, national special allowance recipient, has presided over 1 national research project and multiple provincial-level research projects. He has obtained 26 invention patents and 12 utility model patents, created 5 provincial-level construction methods, published 3 books. He has been awarded 1 second-grade Prize for National Science & Technology Progress, 3 first-grade Prizes for Henan Science & Technology Progress, 1 second-grade Prize for Fujian Science & Technology Progress, 3 special-grade, 4 first-grade and 2 second-grade Prizes for CREC Science & Technology Progress. He has won the honors such as Henan Science & Technology Leader, Fujian Labor Model, Xiamen May 1st Medalist, etc. He is also selected in National Expert Data-Base in Blasting, and the member of Green Expert Committee of the Ministry of Housing & Urban-Rural Development of China.

**周建军**　1969年生，出站博士后，教授级高工，盾构及掘进技术国家重点实验室副主任，主要从事岩土力学与工程、盾构技术、隧道及地下工程研究；主持国家863计划项目2项、国家自然科学基金面上项目1项、中国博士后科学基金项目1项、中国中铁股份有限公司课题3项等；获发明专利3项、实用新型专利5项；主编和参编国家标准和行业标准各6项；发表科技论文90余篇，出版专著3部；获河南省科技进步二等奖2项、中国铁路工程总公司科学技术一等奖2项、洛阳市科技进步一等奖3项；兼任国家自然科学基金函审专家、国家国际科技合作专家库专家、科技部专家库专家、全国专业标准化技术委员会委员、中国建筑机械标准委员会委员、天津市地下工程建造与安全工程技术中心学术委员、中国土木工程学会隧道及地下工程分会掘进机（盾构TBM）专业委员会委员。

Zhou Jianjun born in 1969, PhD, professorate senior engineer, deputy director of SKLST, specializes in rock-soil mechanism & engineering, shield technology & underground engineering. He has presided over 2 National 863 Plan Projects, 1 National Natural Science Foundation Project, 1 Chinese Post-Doctoral Science Fund Project and 3 CREC Scientific Research Projects, etc. He has created 6 national standards and 6 industrial standards, and published more than 90 papers and 3 books. He has obtained 3 invention patents, 5 utility model patents, and has been awarded 2 second-grade Prizes for Henan Science & Technology Progress, 2 first-grade Prizes for CREC Science & Technology Progress, 3 first-grade Prizes for Luoyang Science & Technology Progress, etc. He is also the NSFC review expert, ISTCP expert, MOST expert, member of National Standardization Technology Committee, member of China Construction Mechanical Standardization Committee, academic committee member of Tianjin Underground Construction & Safety Engineering Center, member of TBM Professional Committee of China Civil Engineering Society, etc.

**郭卫社**　1971年生，教授级高工，中国中铁专家，中铁隧道局集团科技设计管理部部长，长期从事隧道与地下工程技术研发与管理工作；主持和参与国家级科研课题1项、多项省部级重点工程项目；编写专著《越海盾构施工技术》；获发明专利2项、实用新型专利3项；获河南省科技进步二等奖1项、河南省科技成果二等奖1项、中国铁路工程总公司科学技术一等奖1项；兼任中国中铁股份隧道地铁组专家成员，《隧道建设》期刊编委、审稿专家，中国铁道学会轨道交通分会委员，中国施工企业管理协会绿色建造专家委员会专家等。

Guo Weishe born in 1971, professorate senior engineer, CREC expert, director of CRTG Scientific Design Department, engages in tunneling & underground engineering. He has presided over and participated in 1 national research project and multiple provincial-level projects. He has published 1 book, and obtained 2 invention patents, 3 utility model patents, and been awarded 1 second-grade Prize for Henan Science & Technology Progress, 1 second-grade Prize for Henan Science & Technology Achievements, 1 first-grade Prize for CREC Science & Technology Progress. He is also the CREC expert in metro construction, reviewer of technical journal -- Tunnel Construction, member of Rail-Transit Committee of China Railway Society, expert member of Green Construction Committee of China Construction Enterprise Administration Association, etc.

**杜闯东**  1974年生，教授级高工，中铁隧道局集团专家，中铁隧道局集团工程部副部长，从事隧道及地下工程施工技术管理工作；先后参与国家863计划项目2项、国家973计划项目1项；获发明专利2项、实用新型专利4项、省部级工法3项；获国家科学技术进步二等奖1项、河南省科学技术进步一等奖1项、国家优质工程奖1项、中国铁路工程总公司科学技术特等奖1项；获中华全国铁路总工会火车头奖章、中国铁路工程总公司优秀共产党员、中铁隧道局集团十大青年科技标兵、中铁隧道局集团青年科技拔尖人才等荣誉。

Du Chuangdong born in 1974, professorate senior engineer, CRTG expert, deputy director of CRTG engineering department, specializes in tunneling & underground engineering. He has participated in 2 National 863 Plan Projects, 1 National 973 Plan Project, and obtained 2 invention patents, 4 utility model patents, and created 3 provincial-level construction methods. He has won 1 second-grade Prize for National Science & Technology Progress, 1 first-grade Prize for Henan Science & Technology Progress, 1 National Quality Award, 1 special-grade Prize for CREC Science & Technology Progress, etc. He also won the honors such as Locomotive Medalist of China Railway Labor Union, Excellent Communist Party Member of CREC, CRTG Excellent Young Researcher, CRTG Young Scientific Talent.

**李凤远**　1975年生，高级工程师，盾构及掘进技术国家重点实验室总工程师，主要从事盾构及掘进技术研究；主持和参与国家973计划项目2项、国家863计划项目1项、国家国际科技合作专项1项、中国中铁股份有限公司课题13项；获发明专利12项、软件著作权24项；发表论文26篇；获河南省科技进步一等奖1项、二等奖2项，中国铁路工程总公司科学技术特等奖2项、一等奖3项、二等奖4项，洛阳市科技进步一等奖2项、二等奖3项，中国铁道学会、中国施工企业管理协会等奖项5项；获郑州市五一劳动奖章、国家创新人才推进重点领域创新团队核心成员、中铁隧道局集团十大青年科技标兵、中铁隧道局集团十大杰出青年等荣誉；兼任中国土木工程学会隧道及地下工程分会隧道掘进机（盾构TBM）专业委员会委员。

Li Fengyuan born in 1975, senior engineer, chief engineer of SKLST, specializes in shield and boring technology. He has presided over and participated in 2 National 973 Plan Projects, 1 National 863 Plan Project, 1 International S&T Cooperation Program and 13 CREC research projects. He has obtained 12 invention patents, 24 software copyrights, and published 26 papers. He has been awarded 1 first-grade and 2 second-grade Prizes for Henan Science & Technology Progress, 2 special-grade, 3 first-grade and 4 second-grade Prizes for CREC Science & Technology Progress, 2 first-grade and 3 second-grade Prizes for Luoyang Science & Technology Progress, and 5 other prizes by other associations and societies. He also has won honors such as Zhengzhou May 1st Labor Medalist, Core Member of State Innovation Talent Team in Key Areas, CRTG Excellent Young Researcher, CRTG Excellent Scientific Youth, etc. He is also the TBM Professional Committee of China Civil Engineering Society.

**张　兵**  1983年生，高级工程师，盾构及掘进技术国家重点实验室研发部部长，主要从事盾构及掘进技术研究；参与国家973计划项目2项、国家863计划项目3项、国家国际科技合作专项1项、国家重点研发计划专项1项；获发明专利7项、实用新型专利5项；获河南省科技进步二等奖3项，洛阳市科技进步一等奖4项，中国铁路工程总公司科技进步特等奖1项、一等奖2项，中铁隧道局集团科技进步特等奖、一等奖、二等奖各1项；获洛阳市青创先锋人物、中铁隧道局集团十大杰出青年、中铁隧道局集团青年岗位能手等荣誉称号。

Zhang Bing born in 1983, senior engineer, director of SKLST R&D Department, specializes in shield and boring technology researches. He has participated in 2 National 973 Plan Projects, 3 National 863 Plan Projects, 1 International S&T Cooperation Program, 1 National Key R&D Program, and obtained 7 invention patents, 5 utility model patents. He has been awarded 3 second-grade Prizes for Henan Science & Technology Progress, 4 first-grade Prizes for Luoyang Science & Technology Progress, 1 special-grade and 2 first-grade Prizes for CREC Science & Technology Progress. He has won honorable titles such as Luoyang Innovation Youth, CRTG Excellent Youth, CRTG Skilled Youth, etc.

**平台建设**

0.总说：盾构TBM工程大数据中心

中心面向盾构及掘进技术行业，采集世界各地盾构TBM装备参数、地质环境、视频影像等数据，配置专业高性能服务器集群，进行数据存储、计算、分析和发布，深度挖掘数据价值，服务于盾构TBM工程设计、制造再制造、科研实验、风险防控及协同管理等各个领域，满足行业科研、设计、应用、教学各层次数据应用，提升我国盾构TBM行业领域的信息化智能化水平。

1.大数据平台

1.1分布式集群数据中心

包括采集服务器群、处理服务器群、存储服务器群及业务服务器群等，采用分布式集群方式组网、管理，建立盾构TBM工程大数据分析、处理平台。

实验项目

◆盾构TBM高通量数据采集、异步安全传输、测试

◆分布式大数据集群计算、性能测试、分析

◆大数据服务器集群安全控制策略验证性测试

Distributed-Cluster Data Center

◇High-Throughput data collection, asynchronous transmission and test

◇Distributed, cluster, computing performance, test and analysis.

◇Modification test of server clusters, safety and control strategy.

1.2多功能数据协同分析处理中心

主要包括中心控制单元、监控分析电脑、控制及显示单元、视频终端及网络架构等组成。中心大屏幕显示系统可与其他子系统资源共享，可通过IPAD控制终端实现大屏显示系统场景切换及信号的调用。

实验项目

◆多终端数据同步展示测试

◆大数据服务端协同展示、控制测试

Multi-Function Data Co-Analysis Center

◇Multi-Terminal synchronous display

◇Display and control of service terminals

1.3工程大数据智能监控平台

主要包括土压平衡盾构、泥水平衡盾构、敞开式TBM、双护盾TBM及单护盾TBM等多机型施工监控应用基本模块，每个模块主要包括主界面、导向系统、视频监控以及其他系统组成，可实现全类型盾构TBM实时智能监控。

实验项目

◆盾构TBM大数据远程协同展示、测试

◆盾构TBM施工项目远程监控、风险监控测试

Intelligent Monitoring Platform of Construction Big-Data

◇Remote display and test of TBM construction big data

◇Remote construction and risk monitoring

1.4工程大数据综合分析平台

主要包括施工平面图、施工纵断面图、导向参数、掘进参数、综合参数、管片姿态及地面沉降等功能模块，可实现盾构TBM实时掘进的平面图、纵断面图和空间环境等参数查询，以及对导向参数、掘进参数、综合参数、管片沉降和地面沉降等参数的综合分析。

实验项目

◆盾构TBM施工大数据分析、关联分析及测试

◆盾构TBM施工多维度参数灰色关联分析及测试

Comprehensive Analysis Platform of Construction Big Data.

◇Analysis, relation analysis and test of TBM construction big data

◇Multi-Dimension GRA and test of TBM construction big data

1.5工程大数据协同管理平台

主要包括基本信息、决策管理、风险管理、设备管理、施工管理、测量管理及状态管理等功能模块，可实现盾构TBM项目安全、质量、进度、成本等方面的远程信息化管理和技术决策，同时在风险管理、设备管理、施工管理、测量管理及状态管理等方面对工程项目开展管控。

实验项目

◆盾构TBM施工项目过程管理节点功能分析、测试

◆装备多维度参数管理功能分析、测试

◆施工项目多维度协同管理、分析和测试

Collaborative Management Platform of Construction Big Data

◇Management, analysis and test of construction process

◇Management, analysis and test of equipment parameters

◇Multi-Dimension collaborative management analysis and test of construction projects

1.6工程大数据智慧应用平台

主要包括装备选型、可视化辅助巡航、智能诊断、状态自适应预警及刀具故障预测预警等功能模块，可针对管片参数、关键参数、沉降参数、导向参数等，开展智能诊断、状态自适应预警、刀具故障及预测预警、辅助巡航等智慧应用。

实验项目

◆盾构TBM掘进主动参数分析及被动参数结果对比测试

◆盾构TBM施工多项目多维度参数关联分析、验证

Intelligent Application Platform of Construction Big Data

◇Test and comparison between analysis results and actual parameters

◇Multi-Dimension GRA and verification of equipment parameters

1. 刀盘刀具实验设备

2.1 MTS815岩石力学性能试验机

由美国MTS公司生产的专门用于岩石及混凝土的三轴伺服刚性试验机，具备轴压、围压和孔隙水压三套独立的闭环伺服控制功能，可开展岩石及混凝土的单轴/三轴压缩试验、蠕变/松弛试验、流固耦合试验等，可实现最大轴向压力/拉力4600kN/2300kN，最大动态围压140MPa，最大孔隙水压力140MPa。

实验项目

◆岩石（或混凝土）和固态材料的单轴压缩、三轴压缩以及拉伸实验

◆渗透实验、流-固耦合实验

◆岩机作用机理、刀盘刀具优化设计、岩石力学性能数据库建立

MTS815 Triaxial Rock Mechanics Rigidity Servo Testing Machine

Uniaxial compression test, triaxial compression test and tensile test on rock (concrete) and other solid materials

◇Permeation test, fluid/solid coupling test

◇Data base for rock-breaking mechanism, optimization design of cutter-head and cutting tools, rock mechanical property

◇Parameter determination of rock strength, elastic moduli. Poisson ratio, etc

2.2 岩石磨蚀性电液伺服实验仪

主要用于分析岩石CERCHAR磨蚀值和分析磨蚀全过程“岩-机”相互作用；数据采集最小间隔1ms，可实时获得钢针水平位移值、力值、钢针磨蚀值、岩石凹痕深度。

实验项目

◆盘形滚刀寿命预测（根据测量的CERCHAR值，评价岩石对刀具的磨蚀性）

◆建立岩石磨蚀性数据库（针对工程中的岩体测量其磨蚀值，建立数据库，可为刀盘设计提供重要参数）

◆岩机作用机理研究（可实时获得岩石磨蚀过程中的水平力、位移等监测曲线，分析刀具和岩石的作用过程）

Servo-Controlled Rock Abrasiveness Testing Machine

◇Life-Time prediction of disc cutter (evaluation of the abrasiveness of cutters by testing CERCHAR value)

◇Data base for rock abrasiveness (provision of important parameters for cutter-head design)

◇Researches on rock-abrasion mechanism (real-time monitoring curves of horizontal forces and displacements)

2.3滚刀复合磨损实验平台

由水平加载测控分系统、垂直加载测控分系统、缩尺滚刀与岩样相互作用机构、缩尺滚刀测量部分组成，主要针对“岩-机”磨损的相互作用，可进行全过程水平方向位移或压力伺服控制、垂直方向速度闭环伺服控制，测试滚刀磨损的磨损质量以及岩石的破岩量。

实验项目

◆滚刀破岩与磨损的过程模拟实验

◆滚刀纯滚动破岩磨损过程实验

◆考虑岩碴影响的滚刀滚动磨损过程实验

◆常压、带压条件下滚刀磨损研究

Scale-Cutter Wear Testing Machine

◇Wear process simulation of disc cutter breaking rocks

◇Wear process simulation of disc cutter rolling on rocks

◇Wear process simulation of disc cutter rolling on rocks under the impact of rock shatters

◇Wear process simulation of disc cutter in atmospheric or pressurized condition

2.4 岩石及合金成分分析仪

手持式合金岩石成分分析仪，用于分析地层化学成分、元素组成、岩土模态等，为盾构设计、选型、施工提供实验依据，并含VGA高分辨率CCD摄像头、数据与GPS绑定功能、数据与GPS输出、GIS 数据采集手簿、Arcpad软件、ioGAS软件。

实验项目

◆现场检测土壤、岩石、碎片、泥浆中元素含量

◆现场测定土壤等级

Rock & Alloy Compositional Analyzer

◇Field detection of element content in soil, rock, slurry, etc

◇Field detection of soil erosion

2.5超声波探伤仪

利用超声波反射、多普勒效应、透射等原理获取被测物体内的信息，可无损伤、精准地检测材料性能和内部结构变化。

实验项目

◆无损检测工件内部裂纹、疏松、气孔、夹杂等缺陷

◆对结构内部缺陷进行定位、评估和诊断

Ultrasonic Flaw Detector

◇Nondestructive testing of fissures, scars, pores, impurity and other flaws

◇Positioning, evaluation and diagnosis of flaws

2.6超声波测厚仪

根据超声波脉冲反射原理来进行厚度测量，可无损伤、精准地测量金属及其它多种材料的厚度。

实验项目

◆测量各种管道和压力容器厚度

◆监测管道和压力容器在使用过程中受腐蚀后的减薄程度

Ultrasonic Thickness Gauge

◇Measurement of pipe’s and container’s thickness

◇Detecting and Monitoring the corrosion of pipes and containers

2.7 回转式TBM岩机作用实验平台

国际首台直径最大的回转式滚刀机理实验台，用于开展滚刀破岩机理实验，为盾构刀盘刀具设计的关键参数提供数据基础，采用高精度控制器进行数据采集与控制，采用高速摄像机及声发射装置观察破岩全过程。

实验项目

◆不同类型岩石的最优破岩刀间距实验

◆盘形滚刀刀圈结构形式与破岩效能的关系实验研究

◆盘形滚刀推力计算模型实验研究

◆研究滚刀压力与侵深之间的关系曲线

Experimental Platform of TBM Breaking Rocks

◇Researches on the optimization of cutter-spacing according to different rocks

◇Researches on the relationship between disc-cutter structure and rock-breaking efficiency

◇Researches on computational model of disc cutter’s pressing force

2.8 刀具线性切削试验台

利用门架结构满足刀具高速、大应力切削的力学要求，采用螺旋传动保证推进方向的高位置精度控制，利用液压系统实现岩箱进给动作的执行及各级速度的调节；能搭载单把12~19＂等规格的盘型滚刀，通过0~1m/s范围无极调速、定侵深破岩（贯入度）等手段对滚刀、刮刀的破岩力学特性及刀具承载能力、破岩机理等方面进行试验、测试和数据存储。

实验项目

◆单刀静压实验

Linear Cutting Platform of Cutters

◇Static cutting experiment with single cutter

◇Linear rolling mechanism experiment with single cutter

2.9 高速摄像系统

包含控制主机、外置摄像机、显微摄像机、内窥摄像机等设备，可实现物体破坏过程瞬态抓拍并高倍数放大，拍摄速度可达4000fps，解析度高达640×480。

实验项目

◆岩石破碎瞬态拍摄

◆狭小空间设备内部检测

High Speed Camera Instruments

◇Transient shooting of rock fragmentation

◇Endoscopic prospecting into small piece of equipment

2.10 声发射检测实验系统

采用多通道同步采集数据，完整采集整个实验过程的声发射信号，可根据采集的波形，精确设定声发射参数提取条件，进行精确定位，并以文本格式或二进制格式导出，以便使用MATLAB等工具进行波形分析。

实验项目

◆对压力容器和金属结构进行无损检测

◆物体结构的受力状态监测

Acoustic Emission Experimental System

◇Nondestructive detecting

◇Stress state monitoring

2.11 3D扫描检测试验装置、3D摄影检测试验装置

包括DigiMetric 3D摄影测量仪和OKIO-II-400 3D扫描仪等实验仪器设备。3D摄影测量仪可进行大构件精密测量及变形检测和超大物体整体控制定位；3D扫描仪主要用于小构件非接触式测量，也可用于大构件质量对比实验及精密部件的逆向工程。

实验项目

◆盾构大构件关键尺寸检测

◆盾构及大型结构件制造、装配误差检测

◆成型隧道衬砌变形检测

◆管片三环拼装质量检测

3D Scanning Instruments 3D Filming Instruments

◇Dimension detection of key and large shield components

◇Error detection in the process of manufacturing and assembling large shield components

◇Deformation detection of tunnel lining

1. 系统集成与控制

3.1盾构TBM自动化控制信号发生实验平台

基于S7-300PLC系统，可实现主从及分布式控制系统硬件组态设计和开关量、模拟量、伺服驱动等自动控制，同时可进行MODBUS，CAN等总线协议之间的通讯。

实验项目

◆信号发生系统硬件组态、测试

◆自动控制系统硬件组态、测试

◆基于西门子S7-300 PLC的以太网络、分布式控制系统硬件组态设计

Signal Generating Platform for TBM Automatization

◇Detection and configuration of signal generating system

◇Detection and configuration of automatic control system

◇Configuration design of Ethernet distributed control system based on S7-300 PLC

3.2 盾构TBM自动化集成控制与检测实验平台

基于S7-400H PLC系统，能有效提高整个系统的可靠性和抗故障能力，可进行不同工业自动化控制算法设计及室内实验，也可用于实验教学盾构操作维护技能培训。

实验项目

◆伺服模拟装置系统硬件组态、测试

◆基于S7-200 PLC设计自动控制软件

◆基于施耐德PLC设计自动控制软件

◆基于S7-400H PLC设计冗余系统硬件组态及自动控制软件设计

◆基于西门子PLC和施耐德PLC设计PROFIBUS总线和CAN总线之间的转换

◆工业自动化控制系统软件设计、土压平衡盾构控制系统软件优化设计及教学培训

System Integration & Detection Platform for TBM Automatization

◇Detection and configuration of servo-controlled simulation system

◇Development of automatic control software based on S7-200 PLC

◇Development of automatic control software based on Schneider PLC

◇Development of automatic control software and redundant system configuration based on S7-400H PLC

◇Design of conversion between PROFIBUS bus and CAN bus based on Siemens PLC and Schneider PLC

◇Development of automatic control system software, operation training and software optimization of EPB control system

3.3 SMD-IR型BGA精密焊接中心

包括精密光学对中系统、自动温度曲线生成软件、微机控制的加热系统，适用于焊接、拔除或返修BGA、CSP、LGA、QFP、PLCC和BGA植球，专为标准或无铅焊接的大小电路板设计。

实验项目

◆BGA芯片的植锡、除胶和焊接试验

◆基于BGA焊台标准的回流焊控制方式，进行BGA芯片

　返修测试

◆BGA芯片焊台上加热头、下加热头、红外预热三个温

　区温度匹配测试

SMD-IR BGA Precision Welding Bench

◇Tin ball melting & reflow, adhesive cleaning and welding

◇BGA chip repair by standard reflow soldering

3.4液压闭环驱动控制实验平台、推进柔顺性控制实验平台、管片安装多自由度机构实验平台

主要用于盾构电液控制系统和关键元器件性能测试及相关实验研究，对盾构刀盘驱动、液压推进、管片拼装、螺旋输送机等系统性能进行综合测试，检测评估盾构液压系统核心元器件和子系统，开发智能控制系统。

实验项目

◆盾构电液控制系统的综合性能实验与评价

◆盾构电液控制系统现场故障的实验室再现和分析

Close-Loop Driving Control Platform，Thrusting Compliance Testing Platform，Multi-DOF Segment Erecting Platform

◇Experiments and evaluations on the performance of shield electro-hydraulic system

◇Playback and analysis of failures of shield electro-hydraulic system

◇Life-Time experiments on core parts and subsystems of shield electro-hydraulic system

3.5液压综合试验台

单机最大功率315kW，总功率400kW，可对各种品牌及型号的液压泵、马达和阀的各个性能指标进行测试；能够在全工况下测试排量在15~ 750mL/r的液压泵、排量在0~500mL/r的液压马达、换向阀、压力阀、流量阀等各类通用阀块。

实验项目

◆泵的耐压、容积效率、启动扭矩和电液控制变量调节特性进行测试

◆马达的机械效率、容积效率和跑合性能进行测试

◆阀的耐压特性、泄漏量、压力调节特性、调压稳定性、流量调节特性、流量负载特性、换向性能和启闭特性等性能参数进行测试

Comprehensive Testing Platform of Hydraulic System

◇Tests of hydraulic pumps on pressure limits, volumetric efficiency, start-up torque and electro-hydraulic control

◇Tests of motors on mechanical efficiency, volumetric efficiency and running-in performance

◇Tests of valves on pressure limits, leakage rate, pressure control, flow control, traffic load, communication performance and open-and- shut characteristics

3.6流体多功能试验台

主要包括水系统、油脂系统、泡沫系统、膨润土系统、空气系统、刀盘喷口试验台、收集装置、配电控制装置等，配置了丰富的仪器仪表传感器，能对各系统的性能、各元器件的性能和参数进行检验和测试。

实验项目

◆泡沫渣土改良装置工业性能测试

Multi-Functional Testing Platform of Fluid System

◇Soil conditioning tests of foaming system

4.盾构施工控制

4.1掘进机综合台架试验检测平台

以垂直和水平姿态，针对各种岩样或相似材料，以不同材质的刀具、刀间距布置和不一样的破岩切削速度、贯入度开展实验，研究不同刀具参数导致的破岩效率和刀具寿命，为相应的工程配置不同材质的刀具及布置，满足实际施工的需要。

实验项目

◆TBM掘进模拟

◆垂直/水平 掘进模式转换

◆多滚刀破岩测试

◆撕裂刀、切刀高差破岩测试

TBM Boring Platform

◇Simulation of TBM excavation

◇Mode switching between horizontal excavation and vertical excavation

◇Rock-Breaking test of multi-cutters

4.2 EPB渣土改良实验平台

用于实验渣土改良剂的改良性能及不同渣土改良剂的添加比例，可模拟土压平衡盾构掘进的过程实验、螺旋输送机出土过程及土塞效应实现过程，实现渣土改良。

实验项目

◆土压平衡盾构掘进的四种状态过程实验（敞开式、半土压平衡模式、土压平衡模式、过压掘进模式），研究掘进速度与螺旋输送机转速关系

◆针对松散砂土地层，研究“土塞”形成效应和螺旋输送机“喷涌”现象，获得添加剂成分与渣土改良性能的关系

◆针对粘土地层，研究渣土搅拌扭矩情况和掘进速度；通过添加不同改良剂，观察渣土流塑性情况，得到改良剂成分与刀盘扭矩、掘进效率的关系

 EPB Soil Conditioning Experimental Platform

◇Experiments on four EPB excavation modes (open mode,half-EPB mode,EPB mode and over-pressurized mode) to study the relationship between excavation rate and rotating speed of screw conveyor

◇Experimenting on loose sandy soil, this system facilitates researches on the causes of Plug Effect and soil gushes at screw conveyor, and on the relationship between conditioning performance and conditioner ingredients.

◇Experimenting on clay soil, this system facilitates researches on agitating torques and excavation rate; by adding different conditioners and observing the plasticity of soil, it helps to study the relationship between conditioner ingredients, cutter-head torques and excavation rate.

4.3泥浆性质及泥膜形成综合实验平台

具备完善的孔压监测系统和两套独立的泥浆压力加载系统（气动加压系统、液力自动加压系统），可开展不同泥浆压力及地质条件下的泥膜形成、泥膜劈裂、泥膜闭气性等试验实验，可实现最大1.0MPa的泥浆压力加载。

实验项目

◆渗透实验

◆劈裂实验

◆泥膜性能实验

 Slurry Property and Mud Filming Experimental Platform

◇Permeation test

◇Mud split test

◇Property test

4.4多通道数字应力应变仪

采用动态、静态数据采集，可开展盾构施工数据及地下工程结构应力应变数据采集，并开发数据分析软件进行盾构施工数据分析。

实验项目

◆可测量1/4桥、半桥、全桥和电压，每个通道都有“一键式”快速插座，桥盒、应变计和应变式传感器可以很方便地接入仪器

◆标配动态测量软件DRA-730AD、静态测量软件DRA-730AS、分析功能软件DFA-7610及多通道同时测量软件DFA-7610，可进行施工结构应力应变测试，机械结构件应力应变测试

Multi-Channel Dynamic Data Acquisition Instruments

◇It is capable of testing quarter-bridge, half-bridge, full-bridge converters. There is a “one-key” socket for each channel and convenient connection devices for bridge box, strain gauge and strain sensor.

◇Installed with dynamic measure software DRA-730AD, static measure software DRA-730AS, analysis software DFA-7610 and multi-channel measure software DFA-7610, this instrument is capable of stress strain test of construction structures and mechanical structures.

4.5工程结构模拟实验平台

用于地下工程模型实验的大型实验设备，尺寸为4.5m× 4.7m×4m，主要由机械系统、液压加载系统、水压调节系统、计算机控制系统以及辅助系统等组成。液压加载系统可实现最大1.6MPa的力加载；水压调节系统可实现水压调节加载，可实现最大0.5MPa的水压加载。

实验项目

◆隧道工程的模型实验

◆基坑工程的模型实验

Engineering Structure Modeling Platform

◇Modeling of tunnel construction

◇Modeling of foundation pit construction

◇Modeling of underwater tunnel construction

4.6土压平衡盾构操作智能培训平台、泥水平衡盾构操作智能培训平台

分为泥水平衡盾构培训平台和土压平衡盾构培训平台，各平台主要包括盾构模拟机、盾构模拟操作平台和考官站三大部分，利用计算机技术，创建模拟的盾构作业场景，可高度模拟盾构作业全过程，培训效果直观有效。

实验项目

◆远程在线实时理论培训、模拟考试

◆盾构作业操作全过程仿真培训

◆盾构故障诊断排除培训

◆学员培训档案管理

EPB Driver Training Platform Slurry Shield Driver Training Platform

◇Real-Time online training and examination

◇Shield operation training

◇Fault diagnosis and removal training

◇Trainee archives management

4.7盾构数字化掘进实验平台

研发了国内高仿真盾构掘进虚拟现实系统，揭示了刀具刀盘载荷分布规律及掘进扰动下围岩土体失稳的机理，优化了刀盘刀具在不同地质条件下受力模型及关键参数设计模型，具备虚拟装配、运动仿真、工作过程及各种标矢量场可视化的仿真能力，实现了盾构设备及施工场景的虚拟样机实例研究和盾构仿真操作。

实验项目

◆掘进推力及扭矩载荷数值实验

◆支护力及土体变形数值实验

◆多种地层破岩机理实验

Digital Experimental Platform of Shield Excavation

◇Numerical experiments on thrusting force, torque and loads

◇Numerical simulation on tunnel supporting and ground deformation

◇Numerical experiments on rock-breaking mechanism

4.8盾构数字化设计实验平台

主要包含刀盘数字化设计系统、地质库软件、刀盘参数化软件、刀盘掘进仿真前后处理软件等，研究刀盘结构、开口率、刀具数量及分布规律，并进行数值模拟，以达到优化结构设计的目的，获得最优的刀盘设计方案。

实验项目

◆根据隧道施工边界条件对刀盘进行选型设计

◆根据不同地质参数和边界条件进行地质建模

◆根据不同地质参数和边界条件进行刀盘建模

Digital Experimental Platform of Shield Design

◇Type-Selection of cutter-head according to project’s boundary conditions

◇Numerical modeling of grounds according to various geological conditions and boundary conditions

◇Numerical modeling of cutter-head according to various geological conditions and boundary conditions

4.9虚拟现实人机交互设备、虚拟现实实验平台

利用计算机技术生成逼真的、多感知的三维虚拟环境，可模拟盾构装备三维机械结构及机构运动过程，开展盾构掘进仿真，实现人机交互式虚拟装配，进行工程施工减灾防灾等方面实验。

实验项目

◆盾构施工地面设备操作虚拟仿真

◆地铁盾构车站内施工虚拟仿真

◆隧道内各种后配套施工虚拟仿真

◆管片转运和安装流程虚拟仿真

◆盾构在不同地层中宏观掘进状态虚拟仿真

Man-Machine Interacting Devices VR Experimental Platform

◇Simulation of shield construction site on the ground

◇Simulation of metro station construction

◇Simulation of back-up system operation

◇Simulation of segment transportation and erection

◇Simulation of shield excavation in different strata

4.10曙光PHPC200高性能计算机、曙光工作站

包括PHPC200亿万次高性能服务器、高性能图形工作站，主要用于开展大型装备及工程地质的三维模型设计，开展盾构关键部件及盾构施工结构分析和运算。

实验项目

◆盾构各零部件、装配件、整机及盾构施工地层高精度三维模型的建立

◆盾构各零部件、装配件和盾构施工动态和静态分析

◆盾构施工运动仿真模拟、动画制作及CG渲染、GPU计算

◆流体动力学、工程数据分析

High Performance Server Graphics Workstation

◇3D modeling of shield components, assembly parts, shield machines and geological strata

◇Dynamic and static analysis of shield components, assembly parts and shield construction

◇GPU computation, CG rendering, animation, mechanism simulation of shield construction

4.11三维建模及分析软件(CREO、 CATIA等)

三维建模软件CREO、CATIA主要用来建立盾构数字样机或刀盘、刀具、盾体等相关零部件的三维数字模型，利用其参数化建模功能实现参数驱动建模，为利用ANSYS分析软件开展相关数值仿真研究提供建模平台。

实验项目

◆盾构零部件、装配件及整机建模

3D Modeling and Analysis Software

◇Numerical modeling of shield machine and parts

◇3D modeling of construction strata

4.12 Midas GTS分析软件

将通用的有限元分析内核与岩土结构的专业性要求有机地结合而开发的岩土与隧道结构有限元分析软件，具有三维直观建模、丰富的材料本构模型、多样化的网格划分方式、直观的后处理查看方式及方便的整理分析等功能，支持静力分析、动力分析、渗流分析、应力-渗流耦合分析、固结分析、施工阶段分析、边坡稳定分析等多种分析类型，并提供了多种专业化建模助手和数据库。

实验项目

◆施工过程的静力分析、动力分析、施工阶段分析

◆隧道穿越富水土体的渗流分析、应力-渗流耦合分析、地层的固结分析

Midas GTS Finite Element Analysis Software

◇Static and dynamic analysis, construction process analysis

◇Seepage analysis, stress-seepage coupling analysis and stratum consolidation analysis for the tunnels in water-rich soil

4.13 ANSYS分析软件

大型通用有限元分析软件，能与多数CAD软件接口，实现数据的共享和交换，如CREO、CATIA，主要用来开展多物理场仿真分析，如结构强度分析、热辐射分析、电磁耦合、热-结构耦合分析等，为盾构装备设计研发提供仿真分析平台。

实验项目

◆盾构关键零部件强度分析；

◆主轴承、管片密封件等超弹材料密封性能分析

ANSYS Analysis Software

◇Strength analysis of shield parts

◇Sealing performance analysis of main bearing, segment seals and other elastic parts

◇Numerical analysis of disc cutter cutting rocks

4.14 盾体铰接密封试验台

可模拟中盾盾尾铰接密封结构，筒体密封腔可加入压缩空气，模拟铰接密封的实际工况，通过油缸的动作模拟盾构转弯时铰接密封的工作环境，可更换唇形、矩形、Y型等不同形式的密封进行试验，通过实时在线检测对比各密封的密封性能。

实验项目

◆测试不同结构密封圈的密封性能

Seal Testing Platform of Shield Articulating Devices

◇Seal test of seal rings of various structures

4.15盾尾尾刷密封试验台

可模拟盾尾与管片的配合结构，通过向密封腔内加入水和压缩空气实现对尾刷加压，模拟尾刷的实际工况，主体结构承压10Bar，能够满足试验尾刷密封能力、密封特性及不同盾尾油脂的密封性能。

实验项目

◆盾尾刷密封性能测试

Seal Testing Platform of Shield-Tail Brush

◇Seal test of shield-tail brush

4.16主驱动密封试验台

主要由两道不同的密封腔、一个压力腔（可作为水腔或者压缩空气腔）、两道密封跑道、前后轴和减速机组成，能够承受10Bar的工作压力，可以模拟主轴承密封及润滑的实际工作环境，对主驱动密封进行试验和检测。

实验项目

◆不同结构和材质的主驱动密封的密封性能、使用寿命测试分析

4.16 Seal Testing Platform of Main Drive

◇Seal and life-span test of sealing components of shield main drive made of different materials and with different structures

4.17八通道数据采集故障诊断系统

包含测试主机和测试传感器，具有现场分析、故障判别、数据管理、趋势分析等功能，可用于现场旋转类设备的振动状态检测、分析和故障诊断。

实验项目

◆电机主轴平衡性能监测

◆齿轮磨损、点蚀、松动检测

◆减速箱故障发展趋势分析

◆温度、电流、转速检测

8-Channel Data Collection & Fault Diagnosis System

◇Balance monitoring of motor’s main bearing

◇Tests of gear’s wear, corrosion and loose

◇Development analysis of reduction-box faults

4.18液压测试仪套件

主要用于盾构机液压系统流量、压力、转速等关键参数的测试仪器；压力测量范围：0～60MPa；流量传感器的测量范围：16~600L/min；转速传感器DS03根据反射光栅原理进行转速测量，测量范围：50~500mm，测试范围：0~30000r/min。

实验项目

◆液压马达/泵的流量、压力、温度及转速测试

Hydraulic Testing Suites

◇Flow, pressure, temperature and rotation speed measurement

4.19便携式超声波流量计

利用两个探头之间传播的超声波信号测量流体流速和流量，测量过程中无需与被测流体接触，测量精度不受导电率、压力、温度及粘度影响；流速范围：液体0.01~25m/s，分辨率：0.025cm/s，测量精度：±0.5%。

实验项目

◆非接触式测量流体流速、流量

Portable Ultrasonic Flowmeter

◇Non-contact test of flow velocity and volume

4.20油水检测设备

配置了最先进的等离子发射光谱仪、分析式铁谱仪、直读式铁谱仪、污染度分析仪、石油产品水分测定仪、全自动微量水分仪、全/半自动运动粘度测定仪、机械杂质离心机、故障听诊器和内窥镜等35种油液检测设备。

实验项目

◆定量分析油液中所含元素的种类及其含量

◆测定设备在用油液的理化性能指标

Oil Testing Equipment

◇Quantitative analysis of the elements and their contents in the oil

◇Physico-chemical property test of the oil

◇Contamination test of oil

1. **荣誉成果**
2. **总说**

**截止2018年底，实验室先后承担国家973计划项目4项、国家863计划项目6项、国家国际科技合作专项1项、国家重点研发计划专项1项、国家自然科学基金项目5项、省部级科研课题20余项；获地市级以上科技成果奖励60余项（其中，国家科技进步一等奖1项、国家科技进步二等奖4项、省部级科技进步一等奖15项、省部级科技进步二等奖21项）；获发明专利59项、实用新型专利31项、软件著作权18项；制修订国家标准13项、行业标准15项；出版专著9部，发表学术论文500余篇（其中，SCI/EI检索36篇）。**

**By the end of 2018, SKLST has taken charge of 4 National 973 Plan Projects, 6 National 863 Plan Projects, 1 International S&T Cooperation Program of China, 1 National Key R&D Plan Program, 5 projects of National Natural Science Foundation, and 20 provincial-level projects; it has achieved over 60 prizes municipal-level and above for science & technology progress (including 1 first-grade and 4 second-grade national ones, and 15 first-grade, 21 second-grade provincial-level ones). In addition, SKLST has obtained 59 invention patents, 31 utility model patents and 18 software copyrights. More than 500 papers (36 in SCI/EI periodicals), 9 scholarly books, 13 national standards and 15 industrial standards have been published.**

1. **盾构装备自主设计制造关键技术及产业化**

**通过对盾构自主设计制造关键技术研究，揭示了密封舱压力分布规律，发明了密封舱压力动态平衡控制方法，突破了多系统协调控制技术，解决了因界面失稳导致地面塌陷的难题；提出了盾构载荷顺应性设计方法，解决了因载荷突变导致系统失效的难题；提出了基于盾构姿态预测的推进控制方法，发明了盾构推进压力/流量复合纠偏技术，解决了因掘进方向失准造成盾构掘进偏离设计轴线的难题。**

**获2012年度国家科学技术进步一等奖；获发明专利77项、软件著作权16项；制订国家及行业标准2项；发表SCI/EI论文190篇，出版专著3部；研究出了能同时适应软土、风化岩、软硬不均地层、砂层及砂砾石地层的复合盾构，填补了我国在复合盾构领域的空白，实现了从盾构关键技术到整机自主制造的跨越，使我国的盾构设计与制造水平迈进了国际先进行列。**

**Key Technologies and Industrialization of Shield Equipment Independent Design and Manufacture**

**This project reveals the pressure distribution in sealing chamber, invents dynamic control methods for pressure control in sealing chamber, proposes multi-system coordination control techniques, and solves the surface settlement problem caused by surface instability; it also proposes design methods for shield load compliance and solves system failures caused by sudden loads; it creates shield-thrusting control technology based on shield motion prediction, invents composite correction techniques for shield thrusting pressure/flow, and solves the deviation problem of shield excavation caused by incorrect excavation direction.**

**This project won the first-grade Prize for National Science & Technology Progress in 2012, obtained 77 invention patents, 16 software copyrights and 2 national and 2 industrial standards. There were 190 papers and 3 books published and collected in SCI/EI periodicals. This research developed China’s first mix shield, which could cut soil, weathered rock, sand, gravel and other complex grounds.**

1. **跨江越海大断面暗挖隧道修建关键技术与应用**

**通过构建跨江越海隧道结构设计理论与方法，解决了水下隧道与陆域道路连接、水下大断面交叉立交隧道结构设计难题；创建了跨江越海隧道施工防突水的控制技术体系，破解了水下隧道施工中极易发生突水灾难性事故的技术难题；创立了跨江越海隧道盾构掘进核心技术体系，突破了高水压下盾构长距离掘进的技术障碍；**

**获2016年度国家科学技术进步二等奖，获发明专利11项、实用新型专利3项、国家级工法1项、软件著作权1项、省部级工法2项。该成果整体应用于我国首座水下立交隧道——长沙营盘路湘江隧道等多座隧道工程，并推广应用到了衡阳湘江隧道、汕头苏埃海湾隧道、青岛地铁一号线跨海隧道工程等多座在建跨江越海隧道工程，其多项关键技术填补了国内外空白，有力地促进了我国跨江越海隧道的技术进步。**

**Key Technologies and Applications for Large-Face Underwater Tunnel Construction**

**This project puts forward theories and methods for underwater-tunnel structure design, and overcomes the difficulties in land-to-water tunnel construction as well as the design of large-face over-crossing underwater tunnel. It develops systemic technologies for water-gush prevention during long and large underwater tunnel construction and solves the problem effectively. It also conquers the key technologies for high-pressure and long-distance tunnel construction.**

**It won the second-grade Prizes for National Science & Technology Progress in 2016, and has obtained 11 invention patents, 3 utility model patents, 1 software copyright, and created 1 national and 2 provincial-level construction methods. Its fruits have been applied to China’s first over-crossing underwater tunnel -- Rd. Yingpan Tunnel in Changsha and other tunnel projects under construction such as Xiangjiang Tunnel in Hengyang, Su-Ai Tunnel in Shantou, Qingdao Metro Line 1, etc. Its fruits filled China’s blanks in long-distance underwater tunnel construction.**

1. **高速铁路狮子洋水下隧道工程成套技术**

**创建了高速铁路水下盾构隧道结构体系与设计方法，突破了以“盾构地中对接”新技术为核心，适应长距离、高水压、严重软硬不均地层的盾构施工关键技术与装备，创新了高速铁路特长双孔水下隧道运营控制关键技术，系统解决了高速铁路特长水下盾构隧道工程设计、施工、装备、运营中的系列难题。**

**获2018年度国家科学技术进步二等奖、国家优质工程奖、中国土木工程詹天佑奖和菲迪克优秀工程奖；获发明专利12项、实用新型专利10项、软件著作权1项；编写省部级工法9项、行业规范1项；出版专著2部、论文62篇。成果整体应用于世界首座高速铁路水下盾构隧道、我国建成的最长水下隧道和首座铁路水下隧道——广深港高铁狮子洋隧道，打破了我国铁路“遇水架桥”的常规思维，实现了世界高速铁路水下盾构隧道从无到有的突破，被誉为“世界高速铁路隧道修建技术的里程碑”。**

**Complete Technologies for High-Speed-Railway Underwater Tunnel -- Shiziyang Tunnel**

**This project puts forward structural systems and design methods for high-speed-railway underwater tunnel. With breakthroughs in the core technology of shield docking, it yields the equipment and construction technologies for long-distance and high-pressure tunnels in extremely heterogeneous strata. It conquers the key technologies for the operation of long-distance high-speed-railway underwater twin tunnels and systematically solves the difficulties in the design, construction, equipment, operation of underwater high-speed-railway tunnel.**

**It has won a second-grade Prize for National Science & Technology Progress, National Quality Project Award, Zhan Tianyu Award, FIDC Award, and obtained 12 invention patents, 10 utility model patents, 1 software copyright, and yielded 9 provincial-level construction methods, 2 books, 1 standard and 62 papers. Its fruits have been applied to Shiziyang Tunnel of Guangzhou-Shenzhen-Hongkong High-Speed-Railway, which is China’s first underwater railway tunnel, first high-speed-railway underwater tunnel and longest underwater tunnel. Having made the record of building the world’s first high-speed-railway underwater tunnel, it breaks the mindset of “bridging over waters” by proffering another option -- “tunneling under waters”, hailed as a monument of high-speed-railway tunnel construction in the world.**

1. **异形全断面隧道掘进机设计制造关键技术及应用**

**针对超大异形全断面开挖、异形多曲率管片拼装等难题进行了深入研究，在超大异形全断面开挖技术、紧凑型刀盘驱动设计与多驱动联合控制技术、异形断面多曲率管片拼装机可靠性技术等十大方面实现突破，研发出新型多刀盘多驱动联合开挖技术、双螺旋耦动互馈与顶推载荷顺应性的土压自适应平衡技术，构建了管片拼装位姿的多体动力学模型，首创了7自由度管片拼装机构，成功研制出世界首创超大（10m级）异形全断面隧道掘进机，填补了国内开挖异形断面规格大于70m2的空白。**

**获2018年度国家科学技术进步二等奖；获发明专利6项、实用新型专利6项、软件著作权2项。该成果成功应用于郑州中州大道、新加坡汤申线、蒙华铁路白城隧道等十余工程，并在既有民居、商场等建筑群体地下联通作业项目中得到推广，为城市主干道下穿隧道、地铁站过街隧道、地下停车场、综合管廊、城市地铁双线隧道等市政、交通建设起到引领示范作用。**

**Key Technologies and Applications for Special-Shaped Full-Face TBM Design and Manufacturing**

**Focusing on full-face excavation, multi-curve segment erection and other difficulties in special-shaped tunnel construction, this project makes breakthroughs in ten technologies such as full-face excavation of large special-spaced tunnel, design & coordinate control of combined cutter-head driving system, reliable multi-curve segment erection, etc. It develops coordinate excavation technologies of combined cutter-head, double-screwer coordinate control technologies, kinetic modeling of segment erection, 7 DOF segment erector, and so on, which contribute to the development of the special-shaped TBM with the world’s largest excavation face (over 10 m high, 70 m2 area) .**

**It won the second-grade Prize for National Science & Technology Progress in 2018, and has obtained 6 invention patents, 6 utility model patents, 2 software copyrights. Its fruits have been applied to projects such as St. Zhongzhou Tunnel in Zhengzhou, Singapore Metro Line, Baicheng Tunnel of Menghua Railway and other projects. It sets a paragon for tunnel constructions beneath existent buildings.**

1. **盾构电液测控方法与系统集成技术**

**通过对盾构电液测控方法与系统集成技术进行研究，自主研发了集刀盘驱动、盾构推进和管片拼装等电液系统模拟与测试功能于一体的盾构电液控制系统综合实验平台，并建立了盾构刀盘驱动液压系统能耗评估模型，解决了刀盘驱动系统高效节能控制、推进系统突变载荷顺应性设计技术、盾构电液系统性能测试等技术难题，为盾构电液控制理论与技术研究提供了原创性的基础实验条件，填补了国内外空白。**

**获2015年度河南省科技进步二等奖、2015年度洛阳市科学技术进步一等奖；获发明专利6项、软件著作权1项；发表论文47篇（SCI收录3篇，EI收录13篇）。经河南省科学技术厅鉴定，本项目技术成果达到国际领先水平。**

**Electro-Hydraulic Control and System Integration Technologies for Shield Machine**

**Focusing on the electro-hydraulic control methods and system integration technologies, this project develops the Shield Electro-Hydraulic Control Experimental Platform and sets models to assess cutter-head’s energy consumption. The platform integrates thrusting system, segment erector, cutter-head driving system and other electro-hydraulic systems together for simulation and test. It conquers energy-saving control technology for cutter-head driving, compliance design technology of thrusting system under dynamic loads, performance evaluation technology of shield electro-hydraulic system and so on, providing an innovative experimental platform for the researches on shield electro-hydraulic control systems.**

**It won the second-grade Prize of Henan Science & Technology Progress and the first-grade Prize of Luoyang Science & Technology Progress in 2015. It has obtained 6 invention patents, 1 software copyright, and published 47 papers (3 in SCI and 13 in EI). Appraised by Henan S&T Department, its fruits has reached the international leading level.**

1. **盾构TBM控制系统可靠性技术开发及应用**

**立足盾构控制系统，从控制硬件可靠性、多电机机械强制同步策略多项关键算法及实验试验验证、工业应用等方面，对盾构TBM控制系统可靠性技术进行专题研究，解决了复杂地层盾构装备推进及主驱动等关键系统传统控制广泛存在的共性问题，有效防控工程风险，提高盾构装备施工的稳定性、安全性和可靠性，推进了盾构TBM装备自动控制技术的发展。**

**获2016年度河南省科学技术进步二等奖、2016年度洛阳市科学技术进步一等奖；获发明专利5项、实用新型专利2项、软件著作权1项；发表科技论文32篇(EI收录12篇)。经河南省科技厅鉴定，本项目技术成果具有原创性、先进性和实用性，达到了国际领先水平。**

**Development and Application of Reliability Technologies for TBM Control System**

**This project studies the reliability technologies for TBM control system from the aspects of system hardware reliability, multi-motor synchronous control algorithms, experimental verification, industrial application, etc. It solves the widely common problems of controlling TBM thrusting system, main driving system and other key systems during the construction in unfavorable strata. It effectively reduces construction risk, elevates the equipment reliability and construction safety, and promotes the development of TBM automatic control technology.**

**It won the second-grade Prize of Henan Science & Technology Progress and the first-grade Prize of Luoyang Science & Technology Progress in 2016. It has obtained 5 invention patents, 2 utility model patents, 1 software copyright, and published 32 papers (12 in EI). According to the appraisal of Henna S&T Department, the research fruits, for its originality, advancement and feasibility, have reached the international leading level.**

1. **盾构刀具试验平台与刀盘设计数字化技术研究**

**通过研发国内外首台直径2.0m可调刀间距滚刀岩机作用综合实验平台，建立了复合式盾构岩机作用理论模型，开发了刀盘刀具数字化设计软件，为盾构装备制造企业提供了可靠的设计平台，为盾构制造和施工企业带来巨大的经济效益和社会效益。**

**获2018年度河南省科技进步二等奖、2013年度中国铁路工程总公司科学技术一等奖、2014年度洛阳市科技进步一等奖；获发明专利3项、实用新型专利2项、软件著作权1项；发表论文20余篇（EI收录6篇），出版专著1部。经河南省科学技术厅鉴定，本项目技术成果先进，创造性强，综合效益显著，达到了国际领先水平。**

**Research on the Experimental Platform of Cutting Tools and Technologies for Digital Design of Cutter-Heads**

**To study rock-breaking mechanism, this project develops China’s first comprehensive experimental platform with a 2.0m-diameter cutter-head, of which the cutting-spacing is adjustable. It establishes theoretical models to study the mechanism of mix shield breaking rocks and develops a digital software for the design of cutter-head and cutting tools. It provides a reliable design platform for equipment manufacturing enterprises and has brought in great social and economic benefits.**

**This project has won the first-grade Prize for Henan Science & Technology Progress in 2018, the first-grade Prize for CREC Science & Technology Progress in 2013, the first-grade Prize for Luoyang Science & Technology Progress in 2014. It has obtained 3 invention patents, 2 utility model patents and 1 software copyright. There has been 1 book and more than 20 papers published (6 collected in EI). Appraised by Henan S&T Department, this project yields advanced fruits and brings in remarkable comprehensive benefits, and has reached the international leading level.**

1. **高水压高智能大直径盾构关键技术开发及应用**

**针对国内当前大直径盾构行业现状开展技术攻关，重点解决了高水压复杂地质条件下的大直径盾构刀盘系统适应性设计及刀具常压更换技术、大直径盾构刀盘驱动系统智能同步控制及推进系统载荷顺应性控制技术、高水压环境下盾构关键系统密封技术等方面的行业难题，最终掌握了高水压高智能大直径盾构关键技术，形成自主知识产权，使我国具备研制大直径盾构装备的能力，为跨江越海隧道大直径盾构设计选型提供技术支持。**

**获2018年度河南省科学技术进步二等奖、2017年度洛阳市科学技术进步奖一等奖；获发明专利7项、实用新型专利2项、软件著作权1项；发表论文13篇。该成果为大直径盾构刀盘设计、关键系统升级改造提供了支持，极大提升了大直径盾构装备研制和应用水平，促进了相关学科的建设，有力地带动了盾构装备产业链的发展，产生了广泛的社会效益。**

**Development and Application of Intelligent Large-Diameter Shield Machine for High-Pressure Geology**

**Composing the difficulties in large-diameter shield machine boring in high-pressure and complex geologies, this project conquers the technologies for cutter-head’s geological adaptability improvement, cutter replacement under atmospheric pressure, synchronous control of driving system, compliance control of thrusting system, sealing improvement under high hydraulic pressure, etc. These technologies, having formed proprietary intellectual property rights, enable China to develop large-diameter shield machines and provide technological support for large-diameter underwater tunnel construction.**

**This project won the second-grade Prize for Henan Science & Technology Progress in 2018 and the first-grade Prize for Luoyang Science & Technology Progress in 2017. It has obtained 7 invention patents, 2 utility model patents, 1 software copyright, and published 13 papers. Having been used for the R&D of large-diameter shield machines and their core parts, its fruits have promoted the development of the industry and yielded vast social benefits.**