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Recent research efforts by Sun Youxian and his colleagues range from smart sensing and detection and control system security to intelligent control equipment and robotics. The dream of achieving intelligent control of manufacturing is close to realization.



Wu Kong, ping-pong playing humanoid robot, reported by National Geographic Channel *Machine: Impossible*

Host of 2017
IDC ROBOCON
(International
Design Contest)



Twice Gold Medal Winner with the Congratulations of the Jury, International Exhibition of Inventions of Geneva

ZMART Micro Aerial
Robotics Team, 2016 & 2017
Champion, International
Aerial Robotics Competition
(Asia & Pacific area)



Zhejiang University: A Top 3 Chinese University

Located in the picturesque and culture-steeped city of Hangzhou (2016 G-20 Summit host), Zhejiang University is one of China's oldest and most prestigious comprehensive universities. For 120 years, it has never ceased its search for truth and pursuit of innovation.

STUDENTS 53,763	UNDERGRADUATE 46.3%	GRADUATE 53.7%	INTERNATIONAL STUDENTS 6,843
ALUMNI 600,000	8,130 STUDENTS GLOBALLY MOBILE	1,800 GLOBAL PARTNERS	
FULL-TIME FACULTY 3,611	MANAGEMENT & SUPPORT STAFF 5,046	36 COLLEGES & SCHOOLS	
PROGRAMS 800+	32 SUMMER PROGRAMS	7 AFFILIATED HOSPITALS	7 CAMPUSES
3RD IN CHINA Best Chinese Universities Ranking 2018 (ARWU)		87TH IN THE WORLD QS World University Rankings 2018	
13 NATIONAL AWARDS FOR SCIENCE & TECHNOLOGY IN 2017		6,238 SCI PAPERS ZJU has 18 disciplines ranked among world's top 1% (ESI)	



ZJU College of
Control Science & Engineering
In a Nutshell

MAKE IT SMART

Control Science & Engineering

The Chinese manufacturing industry is striving for better energy efficiency and environmental sustainability. To help the country accelerate this transition, ZJU's control science and engineering programme is devoted to providing the technology and talent needed for developing smart manufacturing in China and accomplishing its mission of serving societal demands.

The control science and engineering supports the deep integration of artificial intelligence, information science and manufacturing technology. The programme combines theory and practice to provide overall solutions for real-world challenges. With more than 60 years of development, it has established a solid framework that links fundamental research, technology, standards, equipment, systems, applications and commercialization related to control science and engineering. The programme is poised for significant breakthroughs by focusing on smart perception and analysis, intelligent control and optimization, decision-making and support, as well as smart control equipment and standards.

Creativity
Sustainability
Efficiency

3

Research Institutes

- Institute of Industrial Process Control
- Institute of Cyber-Systems and Control
- Institute of Smart Sensing and Measurement

2

Disciplines

- Control Science and Engineering --
A National "Double First-Class" & A+ Discipline

5 Research Areas

Control Theory & Engineering
Pattern Recognition & Intelligent System
System Engineering
Detection Technology & Automation Service
Navigation Guidance & Control

- Cyber Security

4

National Research Centres / Labs

- The State Key Lab of Industrial Control Technology (1/10 in ZJU)
- The National Engineering Research Centre of Industrial Automation
- The National Engineering Lab of Industrial Control System Security Technology (1/3 in ZJU)
- The National International Joint Research Centre of Quality-targeted Process Optimization and Control

ZJU-CSE Achievements

Various national honours, including a first-class National Science and Technology Progress Award and a National Technology Invention Award

Numerous high-quality publications, including multiple highly cited papers in *Automatica*

Development of China's first international standards for industrial automation: Ethernet for Plant Automation (EPA)

More than 40,000 high-quality plants and systems applied in industry



Control Science & Engineering: Safeguarding Industry Nerve Centres



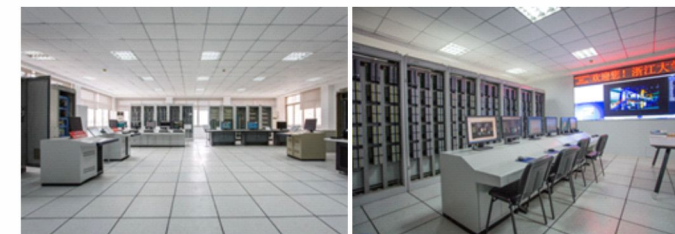
Sun Youxian

From a large refinery plant to a small smart robot, control equipment and systems are essential for the safety and efficiency of modern industry. Yet for China, which did not start large equipment manufacturing until the 1950s, high-end automation equipment has been largely imported.

ZJU researchers' breakthrough in control and automation technology filled this industrial gap nationally. Their technologies are now widely applied in China's paper and pulp, oil refinery, energy, steel, chemical engineering and bio-pharmaceutical industries, contributing significantly to national economic growth.

Control equipment and systems are like the brain and nerve centre for industrial operations and drive advances in manufacturing processes, according to ZJU professor, Sun Youxian, member of the Chinese Academy of Engineering. "We have the manufacturing equipment, but still lack the knowledge to control its operation," said Sun. "We aim to change the situation by developing China's own high-quality automation systems."

One example is the application of automation in steel plants. Top-pressure recovery turbine (TRT) is an energy-recovery unit that employs the heat and pressure of blast furnace top gas to generate electricity. It is widely used in steel plants, because of its great profitability. A reliable control system is essential for ensuring fast and precise top gas pressure control and the safety of the unit. Applying intelligent control and optimization, ZJU researchers upgraded the control system for TRT units by improving the stability of blast furnace top pressure, the control of the turbine speed and the safety of TRT emergency stop control. Specifically, fluctuation of top pressure was controlled to within 1.5kPa, a fraction of the control systems imported from abroad. The setup for such a high-end TRT control system only takes five days, a record for the industry. This technological advancement saves energy, reduces emissions and brings costs down for China's iron and steel industries.



Having established a model of innovation that links fundamental theories, key technologies, international standards and control equipment and systems with industrial application, the college has also provided technological support for many other large-scale projects, including the world's largest coal gasification programme and the largest soda ash factory. Their industrial partners include many renowned enterprises in China, such as Zhejiang Supcon, Hangzhou UWNTEK and Shanghai Electric Group. In 2011, of the four oil refinery projects with a capacity of over ten million tonnes undertaken by China Sinopec, three adopted control systems developed by ZJU researchers.