Facade maintenance robots developed by Hebei University of Technology are used by companies such as General Nuclear Power and China Construction.

LAUNCHING INTO INTELLIGENT ENGINEERING

FROM POWER GRIDS TO SPACE, challenging environments demand adaptable engineered systems that remain viable in extreme settings.

In 2020, the Yuanguang satellite was shot into low Earth orbit, carrying a range of instruments to support vital research. Launched as part of Hebei University of Technology (HEBUT)'s scientific experimental satellites programme, Yuanguang is one of many cube satellites, or cubesats, orbiting Earth. The endgame of the programme is the development of low-cost commercial micro-satellites, as well as other space-oriented industries.

HEBUT's scientific experimental satellites program has collaborated with a host of aerospace institutes and enterprises. This includes the Key Laboratory of Electronic Information Technology for Complex Space Systems, Chinese Academy of Sciences and Tianyi Space Science and Technology Research Institute Co. LTD.

The programme has facilitated studies of the safety and durability of equipment and materials in the especially harsh space environment. It has also served as a testing ground for intelligent robots and systems in extreme settings.

"The experiments of space mechanism and tribology carried out by Yuanguang satellite will provide evidence for the relationship between the perturbation of characteristic parameters at small and medium-sized scales, and the macroscopic dynamic behaviour of complex systems," says Ning Hu, vice-president and professor at HEBUT.

"This will help ensure the accurate and stable operation of complex mechanical systems, and promote the development of intelligent manufacturing industry," he adds.

INTELLIGENT INNOVATION

Hebei University of Technology has a track record in the intelligent robotics arena, and particularly robotics in difficult environments. This includes developing special environment service robots, intelligent construction robots and intelligent health robots, which are now essential to operations across a range of industries.

The team at Hebei University of Technology has also established the only national-level research platform in the field of robot technological innovation in China. Their work has led to nuclear power in-service maintenance robots and facade-maintenance robots, which are used by companies including PetroChina, Sinopec China, General Nuclear Power and China Construction.

HEBUT's high-performance robot tactile-sensing intelligent systems, one of China's 35 'bottleneck' technologies, has been selected as one of the top 50 technologies developed in China, by the China Association for Science and Technology. The tactile-sensing system has been applied to a number of intelligent health robots.

Hebei University of Technology has also been developing its capacity in electrical engineering. A challenge in this area is to maintain the efficiency and integrity of the power grid in the face of an ever increasing proportion of renewable energy in the grid and high demand on it.

A team led by Kui Li, a professor in HEBUT's school of electrical engineering, has developed systems to eliminate the major defects in the principle of leakage protection, solve selective protection misbehaviour; and invented the surge current identification method and a new type of interference suppression circuit topology. Their low-voltage circuit breaker technology has been commercialized and is used by high-profile companies such as Huawei, Siemens, Xiamen Hongfa and Liangxin Electric.

As systems on the Earth's surface, and those orbiting above it, become more complex, the HEBUT team's approach to intelligent engineering will enable problems to be identified and solved efficiently. ■

MAKING NEW ENERGY GAINS

AS DEMAND FOR EFFICIENT, SUSTAINABLE POWER GROWS, Hebei University of Technology is prepared to meet the challenge.

▲ Jianhua Lv's team at Hebei University of Technology has realized green, low-energy production of e-grade carbonate with reactive distillation technology at its core, along with a new type of solid catalyst, which has been licensed to Shaanxi Beiyuan Chemical Group Co Ltd (pictured).

Electricity infrastructure has gone through significant changes recently with a conspicuous shift towards renewable energy in the grid. China, for example, is planning to double its wind and solar power capacity by 2025. This helps bring into focus the engineering challenges of these new power systems.

Research at Hebei University of Technology (HEBUT) covers the full spectrum of intelligent electrical engineering, from the basics of advanced insulating materials and design of new power equipment, to the reliability and intelligence of electrical equipment in complex systems.

THE SYSTEM HAS BROKEN NEW GROUND IN THE INTELLIGENT MANUFACTURING OF ADVANCED LOW ENERGY ELECTRICAL EQUIPMENT.

HEBUT's Collaborative Innovation Center has contributed to the setting of eight national standards for low-voltage electrical apparatus. Research by the centre covers areas such as advanced insulation material design, multi-motor coordinated control and reliability improvement, system status assessment and reliability evaluation have also been applied in power grids, oil fields, steel manufacture and railway systems by companies, including Shanghai World Expo, Capital Airport, Mount Everest Communication Base Station and Shanghai-Tong Railway.

One notable innovation is a 3D magnetic characteristic test simulation theoretical system and experimental method. This system has broken new ground in the science of material simulation technology, particularly in the intelligent manufacturing of advanced low-energy electrical equipment.

"This work can help enhance the intelligent design of large-scale electrical equipment, digital simulation and low-carbon operation," says Yongjian Li, a professor at HEBUT's school of electrical engineering. The technology has been adopted in China's 1,000kV ultra-high voltage transmission demonstration.

CARBON CAPTURE

China's goal to hit peak carbon emissions by 2030 and carbon neutrality before 2060 is reflected in HEBUT's research aims. HEBUT has constructed a series of monoatomic catalysts by modulating the electronic states of monometallic atoms, and has made great strides toward making use of CO_2 by directly and efficiently converting it into high-value-added chemicals, such as CO or urea, through an electrochemical reduction method.

"Improving the efficiency of CO_2 electrocatalysis and the selectivity of the target products is key to making use of CO_2," says Boxiong Shen, a professor at HEBUT. "Overcoming the key challenges of this technology will have a far-reaching impact reducing dependence on fossil energy sources, and environmental pollution," he adds.

The university has developed new technology for using carbon dioxide on a large scale. The on-site method uses waste acid and organic matter from chemical plants, as well as CO_2 from tail gas, to synthesize high value-added electrolytes. A series of patented technologies based on this have been licensed to Shaanxi Beiyuan Chemical Industry Group Company Limited under a lucrative contract. ■

河北工業大学
HEBEI UNIVERSITY OF TECHNOLOGY

022-60438248
office@hebut.edu.cn
www.hebut.edu.cn