Making manufacturing smarter

Researchers at THE SCHOOL OF MECHANICAL ENGINEERING, XI'AN JIAOTONG UNIVERSITY are advancing leading-edge technologies for the manufacturing industry.

Additive manufacturing offers an innovative solution for bone repair. At Xi'an Jiaotong University (XJTU), researchers from the School of Mechanical Engineering achieved the world's first clinical trial of customized mandible implant produced by additive manufacturing in 2001, a breakthrough in personalized treatment for large-scale bone defects.

Additive manufacturing is only one specialism of this century-old school at XJTU, which started in 1913. Now boasting a strong, distinct, and complete academic programme, and a 240-strong faculty, the School of Mechanical Engineering is home to a State Key Laboratory for Manufacturing Systems Engineering, a Key Laboratory of Education Ministry for Modern Design & Rotor-Bearing Systems, and many other advanced research platforms. Fusing hard and soft technologies, the school has contributed to national and regional manufacturing industries through intelligent manufacturing of high-end equipment, and by training and cultivating talented professionals.

Rapid manufacturing systems developed by the school, featuring the integration of processing techniques with data and precision, were promoted in more than 60 service companies and have been used in complex large aerospace structures, and medical instruments. As a major force in additive manufacturing, the school led the way in establishing the National Innovation Institute of Additive Manufacturing in Xi'an, a centre dedicated to the development, standardization, and industrial transformation of these technologies.

Research programmes at the school encompass the full life cycle of major mechanical equipment, from their design and manufacturing to their in service performance. Researchers at the school were the first to propose the basic system engineering concepts of tribology, the science of friction, and summarized its three principles. Their breakthroughs in the design and testing of large-scale sliding and rolling bearings have broad engineering applications. Digitally controlled manufacturing technologies developed at the school are poised to become the foundation for intelligent manufacturing in aerospace, nuclear power, and automotive industries. The school's researchers have also developed a series of cutting-edge technologies with potential for batch production of devices on the micro and nano scale. These manufacturing technologies can support the development of wearable electronics, robots, and bionic devices, among others.

A historically significant problem in mechanical engineering is ensuring the safety of critical equipment in such areas as petrochemical, metallurgy, wind power, aviation and high-speed trains. Monitoring and diagnostic techniques date back to the 1980s. The new paradigm that combines manufacturing design and intelligent operation advocates a transition from scheduled to condition-based maintenance of major equipment.

Along this line, XJTU researchers pioneered high-temperature, high-pressure transduction technologies, special micro-machine dynamic transducers, monitoring techniques for non-stationary operating conditions, holospectrum technology, crack identification using wavelet analysis, fault isolation and intelligent diagnosis. The wind power monitoring and diagnostic systems they developed are used at more than 100 sites in China. The school has also collaborated with a commercial aircraft engine company to establish the United Innovation Centre for health management and operation safety of aircraft engines.

The school plans to further revolutionize large-scale equipment, robotics, interdisciplinary biomedical engineering and other intelligent manufacturing technologies. By innovating the model and format, and cultivating creative talents, it aims to fully transform the potential for technological advance, benefiting the economy, society, and the environment with disruptive technologies. ■

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