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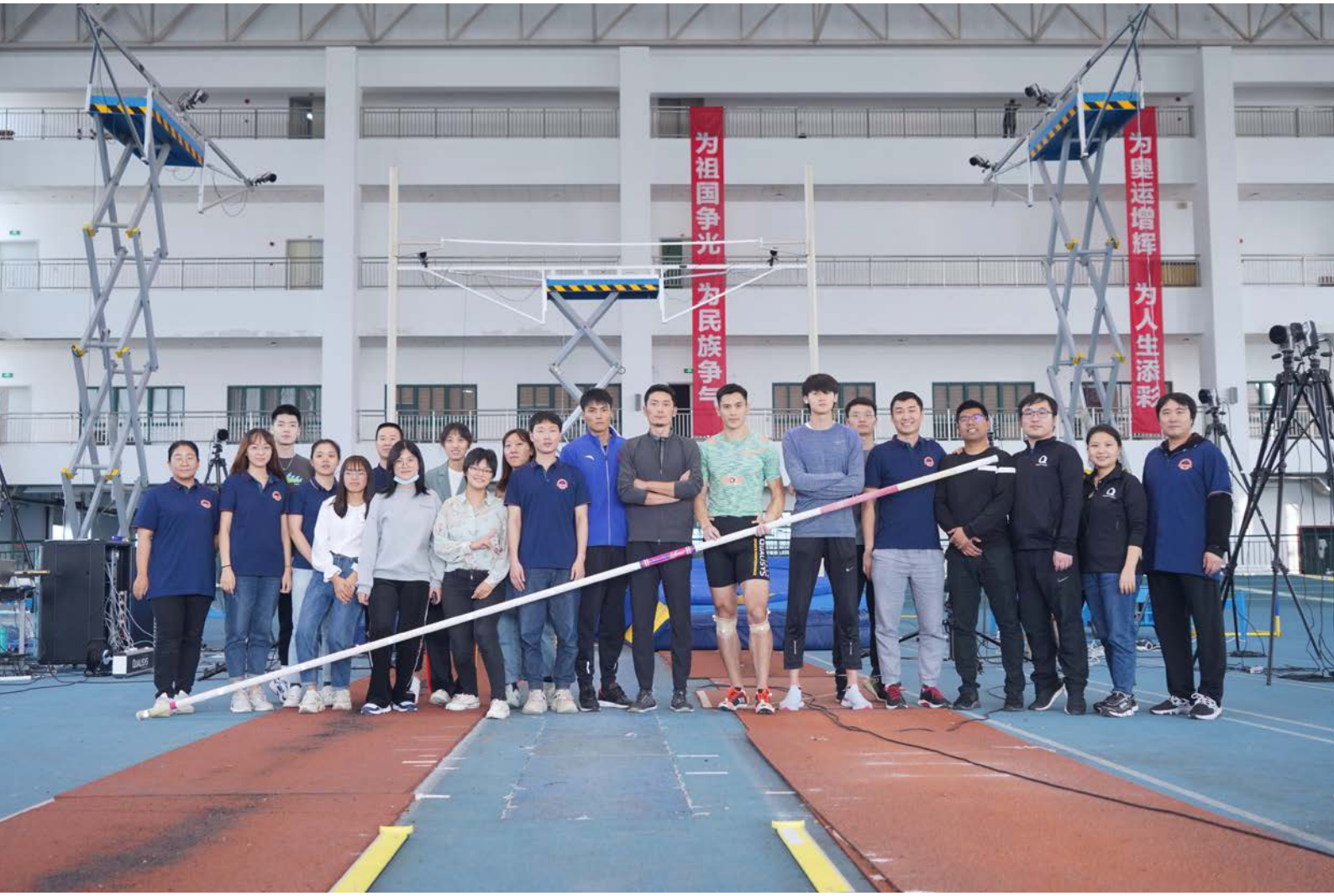

Setting the bar higher

Shanghai University of Sport chooses force plates from Kistler for pole vault research

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The complex sequence of movements in a pole vault, including run-up, planting, take-off and bar clearance, can only be captured properly with highly sensitive and precise measuring instruments.

Professor Liu Yu and his Shanghai-based team of colleagues and students are undertaking research into pole vaulting and performance by top athletes. Assisting the researchers: force plate technology from Kistler, including a new development for the planting box to supply critical biomechanical data about the complex sequence of movements in this sport.

The pole vault occupies a unique position among track and field events. In less than a minute, athletes have to complete a technically challenging routine that comprises several different movement sequences: the run-up with the pole, planting, take-off, turn and bar clearance – and finally, a safe landing. This is an event that sets demanding requirements for the athletes – but not only in terms of purely physical performance. They, and especially their coaches, must also fully understand every dynamic detail of the sequence of movements in the vault.

Since 2018, the Sport Performance Research Center (SPRC) at the Shanghai University of Sport (SUS) has completed several projects involving high-level Chinese and foreign athletes, aimed at analyzing and processing the full range of motions involved in pole vaulting. Biomechanical force plates from Kistler deliver outstandingly accurate measurements of dynamic processes, and are also easy to install: due to these advantages, they have played a crucial part in helping the researchers to understand the instantaneous force changes that occur during a pole vault.

Basic research and development of elite athletes

SUS was founded nearly 70 years ago, making it one of China's longest-established higher educational institutions specializing in sports. The SPRC was added to the university in 2003: its superb hall, including a range of biomechanical equipment, was built with the help of government and municipal funding. The center covers three main research areas. First, biomechanics in competitive sport, with the focus on top athletes and national team members (as well as their trainers, of course): the goal here is to improve performance and athletic abilities in general. The second key area involves collaboration with manufacturers of sports apparel such as footwear, shirts and protective equipment, so that biomechanical information can be exploited to prevent injuries and develop athletes' performance. And the SPRC's third area of interest is research into innovations in various fields: neuropriming is one example.

The SPRC's pole vault project fulfills a dual purpose: on the one hand, China's best athletes are prepared for the next track and field season in the run-up to the Olympic Games, as part of the "Technology-empowered Olympics" initiative launched by the General Administration of Sport of China. The second objective is to study a sport that is chronically under-researched in China, following on from the success of similar programs for sprint, swimming, and ball sports.

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Prof. Liu Yu, Dean of the Research Institute at SUS

To obtain exact measurements of each pole vaulter's run-up (especially the last three steps), the force plates from Kistler can be repositioned with just a few easy maneuvers.

Absolute attention is focused on the vault: the measuring station with evaluation electronics for force plates from Kistler.

Precisely capturing force actions in the movement sequence
"In earlier biomechanical research, it was actually quite difficult to capture such a wide range of 3D motions in their entirety," according to Professor Liu Yu, Dean of the Research Institute at SUS, a national award-winner and Fellow of the U.S. National Academy of Kinesiology, who heads the project. He continues: "Thanks to the system from Kistler, we can capture the movements of the body's center of gravity and also of individual parts of the body, as well as the resultant angles and the length, frequency, and speed of the run-up. What's more, the forces in all three spatial dimensions are measured – including, in particular, the force exerted by the athlete on the ground in his or her last three steps, and when the pole is planted in the box. This kind of information is not available to coaches who only observe athletes with the naked eye."

In research of this sort, data and model quality is critically dependent on precise acquisition of movements and force measurement in real time. Knowing this, the SPRC decided to opt for leading kinematics and biomechanics technology right from the start of the project. Towards the end of 2018, initial tests with three 9287C force plates from Kistler were carried out in the open-air facility; plans were then drawn up for further integration, including the installation work needed for the pole vaulting project. This already allowed trainers and students to try out the equipment and get to know it, greatly reducing the amount of work and time needed to set up the tests.

With assistance from Kistler, it took only half an hour to install the three sets of force plates in the dedicated measurement track for the project in the hall. But to ensure that the data on each pole vaulter's last three steps was as accurate as possible, the force plates had to be aligned in exactly the right positions prior to every test. This was easily achieved thanks to the simple installation procedure for the equipment, so full data acquisition for three athletes was completed in just one day.

Custom measurement solution for the planting box
In addition, the Kistler engineers developed a multi-component force measuring box specifically intended for pole vaulting applications. The box features an exceptionally robust design, and it precisely replicates the function and geometry of the actual planting box. The integrated piezoelectric sensors supply an accurate force curve – from the moment when the pole touches the planting box, as the force increases continuously, until the tension built up in the pole due to deformation is released and the force then decreases as the athlete gradually lets go of the pole. There are extreme changes in the direction and magnitude of the force within fractions of a second – and these fluctuations can only be captured properly by a measuring instrument that has a wide measurement range, high natural frequency and outstanding dynamic sensitivity.

As an international expert on sports biomechanics, Professor Liu emphasizes the great importance of this project: "In conjunction with optical measurement systems, force plates from Kistler have given us a complete picture of the kinematics and dynamics of the athlete throughout the entire sequence of a pole vault. Based on the data we have obtained, we're able to carry out technical analyses, give training recommendations, and compile an accurate model of the movements and performance of each individual athlete."

Data captured with force plates from Kistler can be visualized and comprehensively evaluated with the BioWare software developed for the product.

Find out more about our applications:
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