Medical Xpress

Researchers use sensor technology to improve athletic performance

March 25 2011

(PhysOrg.com) -- A University of Maine track and field coach has teamed up with exercise science and mechanical engineering researchers to improve the performance of his athletes.

A study being conducted on the UMaine campus is employing scientific methods to identify the timing and magnitude of muscle activation during a variety of weight room exercises, as well as movement during competition. The data being collected will help determine the relativity and effectiveness of current training methods and aid in their modification to increase effectiveness.

Study results will have a profound impact on the training techniques employed by track athletes, sprinters in particular, the researchers say. Already, preliminary findings have better informed assistant UMaine track coach David Cusano about which muscle groups need to be the focus of off-track strength and power training sessions in the weight room. He has modified his weight room program so it specifically supports the athletes' explosiveness on the track, helping to shave precious hundredths of a second off their times.

According to exercise science graduate student Thomas Ordelt, seventy percent of the sprinters participating in the research are consistently improving their personal bests in the weight room week by week, but more importantly, they continue to run faster and faster on the track. Ordelt is conducting the research as part of his master's thesis under the supervision of professor Robert Lehnhard, an exercise physiologist in the College of Education and Human Development, and mechanical engineering assistant professor Ashish Deshpande.

The researchers brought together state-of-the-art technology to study the movement and force-generation patterns of the athletes during their block starts on the track, and various weight-training exercises. These included a high-speed motion capture system to precisely record whole body movements, electromyograph (EMG) sensors to measure real-time neuromuscular activity, in-shoe sensors that pinpoint pressures on the sole of the foot and an in-ground force plate that helps calculate the athletes' power.

Similar motion-capture equipment is used for replicating human movement in animated movies such as Avatar, Deshpande says.

"This is really a cutting-edge study since this is the first time all these separate sensing technologies have been coordinated together for the purpose of studying human performance," he says.

Prior to a series of weight-training exercises and block-starts, Ordelt and another exercise science graduate student and co-researcher, Nabil Salim, attached 40 reflective tracking beads from head to toe on 17 men and women athletes. High-speed filming of the markers during movements led to computer models of the athletes performing the exercises. The computerized figures were then be used to calculate a wide range of physics variables that directly apply to sprinting.

In addition, eight EMG sensors were placed on muscle groups in the legs to correlate their "firing" to the acceleration modeled by the computerized figures. A force plate and in-shoe sensors measured ground forces generated by the athletes. Direct-force output data was integrated into the analysis.

Preliminary results have allowed Cusano's sprinters and hurdlers to modify and improve training techniques. Practice sessions have become more efficient and productive, the athletes say.

Sprinter Jillian O'Brien, who participated in the study, says the information she received from Ordelt and Salim, even during the data collection phase, helped her qualify for America East finals in the 60- and the 200-meter dash events. O'Brien, a junior exercise science major from Buffalo, N.Y., believes the knowledge also will help her in the future as a coach and fitness professional.

She and fellow study participants Jesse LaBreck and Cearha Miller all qualified for the recent 2011 NCAA Indoor Track and Field National Championships.

"All three of them set personal bests during the study," Cusano says, "and all three continue to set personal bests. This study has helped them make very effective adjustments in their training, which helped them qualify for this prestigious meet."

A review of the data collected so far also has improved the athletes" ifting techniques says Cusano. For example, the 115-pound O'Brien increased her power clean from 125 to 150 pounds, and her maximal back squat is more than 300 pounds.

Others' performances also improved. Another runner trimmed her personal best 400-meter dash time by a significant 2 seconds. She also shaved a half second from her 60-meter personal best. In a race where the difference between winning and losing can be 100th of a second, sprinting a full half second faster is a tremendous achievement, says Lehnhard.

"The correlation between our weight room work and our performance on the track is exactly what we are looking for,"Cusano says. "A study such as this will help further ensure that we are being smart about our off-track training practices."

Although athletes have been the focus of this particular study, the successful synchronization of these technologies used in the research will lead to the study of human movement in a wide range of other groups.

"Children with degenerative muscular or neurological diseases, older people with loss of balance and people of all ages needing rehabilitation from injuries can benefit from this technology," Ordelt says.

"We can provide mathematical data for building assistive devices for handicapped people," he adds. "Our methods provide a deeper understanding of how the body moves. It's unique that we have so many sensors synched at one time."

Deshpande, whose research interests include design of prosthetics and rehabilitation robotics, agrees. "We're creating novel, interesting scientific methods for human movement analysis," he says. "This goes beyond athletes. We are pushing the technological envelop to understand human movement and apply that understanding toward improving the quality of life for many, many people. It's important for everyone."

Provided by University of Maine