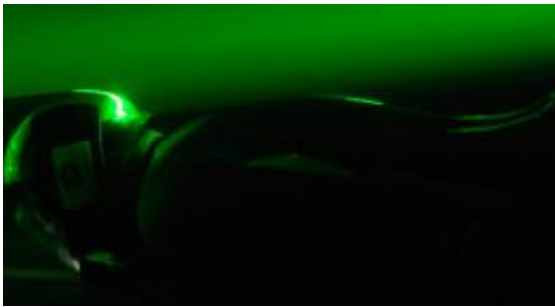


Researchers Using Science To Decode the Secrets of Olympic Skeleton Sliding

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(PhysOrg.com) -- Olympic skeleton athletes will hit the ice next month in Vancouver, where one-hundredths of a second can dictate the difference between victory and defeat.

Using state-of-the-art flow measurements, engineering professor Timothy Wei and students at Rensselaer Polytechnic Institute in Troy, N.Y., are employing science and technology to help the U.S. skeleton team trim track times and gain an edge over other sliders.

“Not much is known about the actual mechanics of skeleton, so we developed a unique suite of tools to help pull back the curtain a bit,” said Wei, head of Rensselaer’s Department of Mechanical, Aerospace, and Nuclear Engineering, who has previously worked with U.S. Olympic swimming coaches and athletes. “Even in the short time since developing

the system, we have learned a whole lot more about how the athlete's suit, helmet, [body movements](#), and positioning affect aerodynamics.”

“The real-time aerodynamics work that Rensselaer has provided for us has helped to fine-tune our athletes' body positions and equipment in a way that we've never experienced before,” said USA Skeleton Technology Coordinator Steve Peters. “These new concepts will give our athletes the data they need to remain competitive with the rest of the world.”

Lying face-down, and hitting speeds of more than 70 mph (112 kph), skeleton athletes maneuver their sleds down an icy, mostly-covered track rife with twists and turns. Skeleton sleds feature no steering or braking mechanisms, so body control and balance are critical for navigating the tracks. A relatively young sport, skeleton was permanently added to the Olympic program in 2002. Skeleton is rigorous on an athlete's body - the vibrations and bodily stress are so intense that even Olympic contenders usually cannot slide more than four times per day, making it difficult to collect data.

So Wei set out to build a system that accurately simulated an actual skeleton run, while collecting as much data as possible. The professor understood that the more drag, or wind resistance, an athlete creates, the slower he or she is going to slide, so Wei needed to find a way to examine all the different variables: the clothing, headgear, and body position of sliders, as well as the skeleton sled itself. Studying drag requires wind, and the skeleton sled was slightly too large to fit into either of Rensselaer's two wind tunnels. The jet of air exiting the exhaust vent of the wind tunnel, however, worked perfectly.

Wei and his students created a replica section of a skeleton track directly behind the wind tunnel. They built sensors into the floor of the replica, onto which they placed a skeleton sled. Each sensor was fit with an

oscilloscope, and sent digital data to a nearby computer that calculated the sled's pitch, roll, and balance - technical terms for indicating if the slider is leaning backward, forward, left, or right. The sensors also measured wind resistance, or drag.

With a skeleton athlete lying on a sled in the test track, Wei turned on the wind tunnel. The steady stream of air exiting the wind tunnel's exhaust replicated the conditions of an actual skeleton run. Wei and his team cut a hole in the bottom of the test track, slid in a computer monitor, and covered the hole with clear plastic. This allowed the athletes to view, in real time, data and graphs clearly illustrating the impact that every little lean or tilt had on wind resistance, and thus on their speed. One side wall of the track was also made from clear plastic, allowing coaches to observe the tests.

Wei and Peters brought 10 different skeleton athletes to Rensselaer for a test run on the new system. They tested a wide variety of skeleton suits and gear, some of which, Wei said, certainly created more drag than others.

“This is more information than these athletes have ever had about the impact of what they're doing while sliding,” Wei said. “It was a real eye-opener for them.”

To further test the athletes, suits, and headgear, Wei also developed a state-of-the-art diagnostic tool using a video-based flow measurement technique known as Digital Particle Image Velocimetry (DPIV). He bounced a green pulse laser off a cylindrical lens to create a thin sheet of light, which he shined over the shoulders of athletes laying the test system. Wei then introduced theatrical fog into the front of the test bed.

Wei videotaped the fog as it was pushed around by the wind tunnel exhaust, and then used sophisticated mathematics, computer modeling,

and stop-motion video to track the behavior of the swirly fog as it rolled off the bodies and heads of the athletes. This data, he said, can be used to identify vortices, pinpoint the movement of air, and hopefully identify new and more detailed methods for skeleton athletes to reduce their drag.

Meanwhile, a team of undergraduate students in the O.T. Swanson Multidisciplinary Design Lab (MDL) at Rensselaer looked at different engineering techniques to help improve the [skeleton](#) sleds. They developed a data acquisition system for the sleds, which measured specific mechanical properties of the sled in real-time as the athlete guided it down the track. One component of this system is a camera that attaches to the slider's helmet, providing athletes and coaches with a new proof-of-concept tool from which to learn.

Wei is no stranger to applying science and technology to the world of sports. He has been working with USA Swimming for several years, using DPIV and other techniques to better understand how swimmers interact with the water. He also created a robust training tool that reports the performance of a swimmer in real-time, measuring how much energy the swimmer exerts with each kick. The tool helped several top-tier [athletes](#) trim seconds from their lap times.

More information: bobsled.teamusa.org

Provided by Rensselaer Polytechnic Institute

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