When Extreme Sports Meet CFD

Creaform's scanning system and computational fluid dynamics expertise push back the speed limits in street luge.

By Pier-Olivier Duval, ing.

Holders of the Guinness speed record in street luge (157 km/h), enthusiasts from Québec City decided to take up a new challenge: Pass the symbolic mark of 100 mph with no engine. Among these thrill seekers was Louis-Étienne Bouchard, account manager at Creaform.

"Our luge team, The 3 Bobs, broke the world speed record in September of 2008, and we came very close to the 100 mph at that time," he says. "Since then, we have tweaked our gear, but we had a hard time figuring out how to improve the aerodynamics of our luges to gain even more speed."

Louis-Étienne and his teammates asked Creaform's digital simulation team to help them out. The goal: Using CFD to simulate airflows to reduce the aerodynamic drag and break their very own speed record.

Step 1: 3D Scanning

To digitally simulate flows, you first need a computer model of the object. In this case, a representation of the surfaces in contact with air was the only thing required, and so it was essential to get the exact 3D reconstruction of the luge racer in sliding position. This was accomplished using a Handyscan 3D handheld portable scanner, developed by Creaform.

Step 2: Fluid Mesh

The surface mesh generated was then used as a starting point to define the air volume around the object to be analyzed. Later, this was divided into several small elements to create the fluid mesh. In this case, the file was made of 3 million elements. Using the Navier-Stokes equations—which arise from Newton's second law when applied to fluid motion—flow characteristics, such as speed, pressure, temperature and turbulence level, were calculated for each of these elements.

Step 3: Analysis and Recommendations

CFD analysis of the fluid model provided data on the flow behaviour of any point on the calculation volume, which makes it possible to calculate with precision the aerodynamic shapes on the body, as well as the air particles.

"By calculating the CFD from the real scanned geometry, we were able to identify several ways to increase the top speed," explains Creaform fluid dynamics specialist Steve Julien. "We found that—with a new profile on the rear of the luge and by modifying the position of the luge racer—it was possible to limit the zones of high pressure while reducing the flow recirculation zones.

"We also found out that the suit created a lot of rugosity at the legs and increased unnecessary chafing," Julien adds. "Thanks to the modifications we made, we were able to easily gain between 5 to 10 km/h. The high accuracy of the scanning file generated with the portable scanner turned out to be very helpful, as it provided us with a wealth of information that we would not have had otherwise."

Step 4: Breaking the Record…Nearly

On June 18, 2012, current Guinness record holder Cédric Touchette laid on his new and more aerodynamical luge, ready to rush down the famous Éboulements hill, located in the Charlevoix area of Quebec. During a practice before the race, officially monitored by the Guinness records organization, mechanical issues arose.

"The wheels started to vibrate and my luge to wobble," Touchette says. "I got pulled off to the left, and I saw the concrete wall coming in on me. When you're rolling that fast, it is really scary. I'm done chasing records for now."

Still, during that "slow" practice race, the thrill seeking Touchette still peaked at 152 km/h, just shy of his 100 mph goal. "I'm still convinced that the new luge could break the record," Creaform's CFD specialist Julien insists, "but I'm not reckless enough to throw myself down that hill to prove it!" DE

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