Berlin's Olympic Goldsmiths

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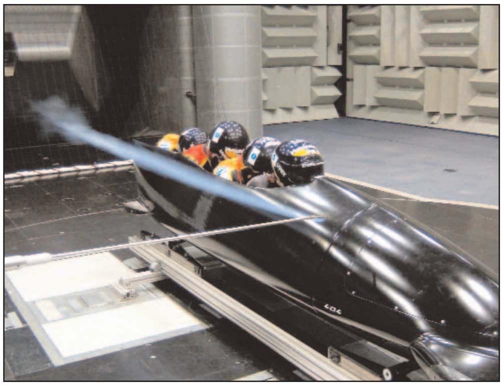
The German bobsled rounds the bend

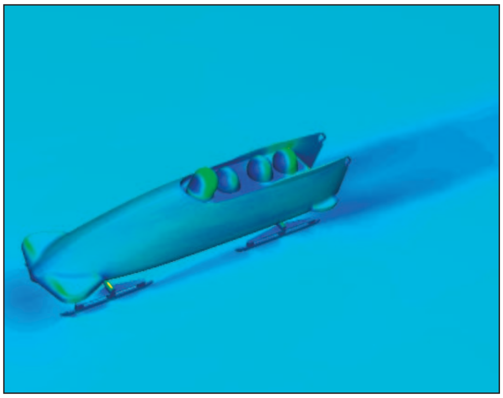
THE INSTITUTE FOR RESEARCH AND DEVELOPMENT of Sporting Equipment (FES) in Berlin has been described as a "gold mine", as the equipment that has been developed there has often proved to make a difference during competitions. Since 1962, engineers, mathematicians, physicists, and craftsmen at the FES have been involved in the development of customized sports equipment for use by athletes in training and competition. Along with sports such as rowing, canoeing, sailing, and cycling, the recent emphasis has been to focus on the upcoming 2006 Winter Olympics in Turin, Italy. Of particular interest are the sleds used for the skeleton and bobsledding events, where it is as important to minimize friction as it is to keep the air resistance of the athletes and their equipment at a minimum.



The 4-man bobsled in the wind tunnel

To achieve enhanced results in this area, the FES engineers have been performing flow simulations using FLUENT. In their view, CFD has become indispensable for equipment development in competitive sports. Over the years, hardware gains have enabled numerical simulation of three-dimensional flow patterns with ample precision and effective comparison between variants. At FES, the goal is not to achieve a comparable result in relation to the wind tunnel, but to create a foundation that makes systematic comparison between variants more reliable.

In the bobsled research, a Linux cluster fitted with AMD Opteron 64-bit CPUs was used for the CFD simulations. Using the cluster, the calculation of a complete model with six million cells could be completed in about an hour. A dual-processor Intel Xeon 3GHz computer with 4 GB of RAM also accomplished comparable tasks in an acceptable time.



Dynamic pressure contours on the sled, ice, and athletes

The realizable k-ε model with standard wall functions was relied upon for all of the computations. Initial trials with the shear-stress transport (SST) k-ω model were also successful. The realizable k-ε model had the advantage of being well-adapted for simulating regions of stalled flow. In addition, the flow underneath the sled is known to generate increased resistance due to the shear between the floor (base layer) and the upper layers of the fluid that are moving faster. To investigate the effect more precisely, a moving base layer was used in the simulations in conjunction with the oncoming air flow boundary condition. Such detailed scenarios could not be properly reproduced in a wind tunnel.

The simulations of different sled variants at FES led to the development of design modifications. One change gained prominence because it caused a significant reduction in resistance. The modification involved the shape of the hood, and it resulted in better formation of the wake area and a subsequent decrease in the strongly turbulent area behind the sled.

As is done for Formula One (F1) race cars, the bobsled prototypes were tested in wind tunnels at TU Dresden and the BMW plant in Munich. The results in those cases were found to be in good agreement with the CFD simulations. After having complied with all of the technical prerequisites for a good performance in the Olympics, Germany's bobsleds should again be in peak position to return from Turin with even more medals. ■