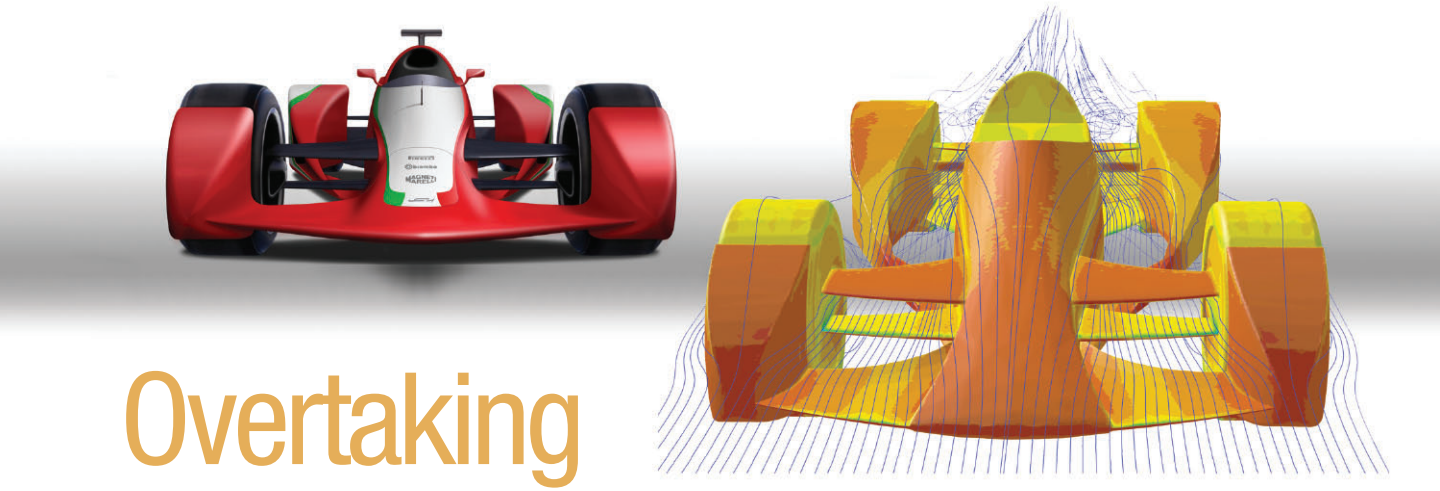


Fluid dynamics software from ANSYS was used to determine the aerodynamics of a concept F1 racecar.

Overtaking Race Car Design

An Italian design firm proposes a Formula 1 car that would bring more excitement to the race.

by Leonardo Fioravanti, Luca Fioravanti and Matteo Fioravanti, Fioravanti srl, Montcalieri, Italy
Matteo Aroni, ANSYS, Inc.

The Italian design company Fioravanti thinks outside the box, especially in the automotive field. At the 2009 Geneva International Motor Show, Fioravanti presented a concept car for Formula 1 (F1) racing. The design team's enthusiasm for the sport led them to design this vehicle that might bring more excitement to the races. The aerodynamics of this innovative race car, the LF1, was studied using fluid dynamics software from ANSYS.

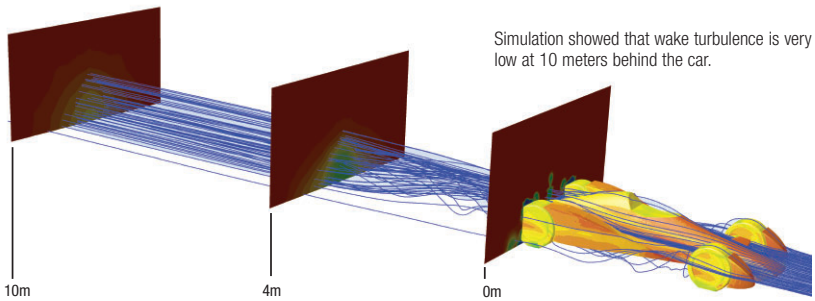
The team designed the vehicle based on proposed regulations for the 2012 F1 season that include many technical advancements with regard to engine size, aerodynamics and tires. The car would house an 1,800-cc turbo engine and use 18-inch wheels. To make it more eco-friendly, the LF1 would use the innovative kinetic energy recovery system (KERS) to reduce fuel consumption.

Aerodynamics is extremely important for F1 racing as it affects performance, cost and aesthetics. In the LF1 car, the radiators and intercoolers were designed to reduce front wheel drag. To limit aerodynamic drag and wake turbulence, the front wing was seamlessly integrated with the front end of the vehicle. This, along with side fairings, contributes to reducing front wheel drag. The large rear wing is integrated into the bottom of the vehicle and generates a consistent down force. The shape of the central body is characterized by a lift–down-force ratio close to zero.

To verify the effectiveness of the LF1 aerodynamic design, Fioravanti conducted a study using ANSYS FLUENT software. The design team generated a 10 million polyhedral cell grid from a 3-D CAD model. The polyhedral grid is equivalent to 50 million traditional tetrahedral elements and provides considerable savings in computational time. Using the software as a virtual wind tunnel, the designers simulated a wind speed of 180 kilometers per hour in order to investigate the wake performance of the LF1. Appropriate speed was assigned to the ground and wheels.

It took only three days to complete the simulation, starting with the 3-D CAD model. ANSYS FLUENT software allowed Fioravanti to analyze and visualize the aerodynamic field in detail. Simulation showed that the energy recovery of air flow in the wake of the LF1 is nearly complete 10 meters behind the car, so another car following at that distance or greater would not suffer degradation in aerodynamic performance.

Fioravanti hopes that when the 2012 regulations are enacted for this sport, teams will be compelled to verify air flow energy recovery and turbulence in the wake of their cars. This would allow drivers to overtake more frequently and make the race more exciting. ■



Simulation showed that wake turbulence is very low at 10 meters behind the car.