

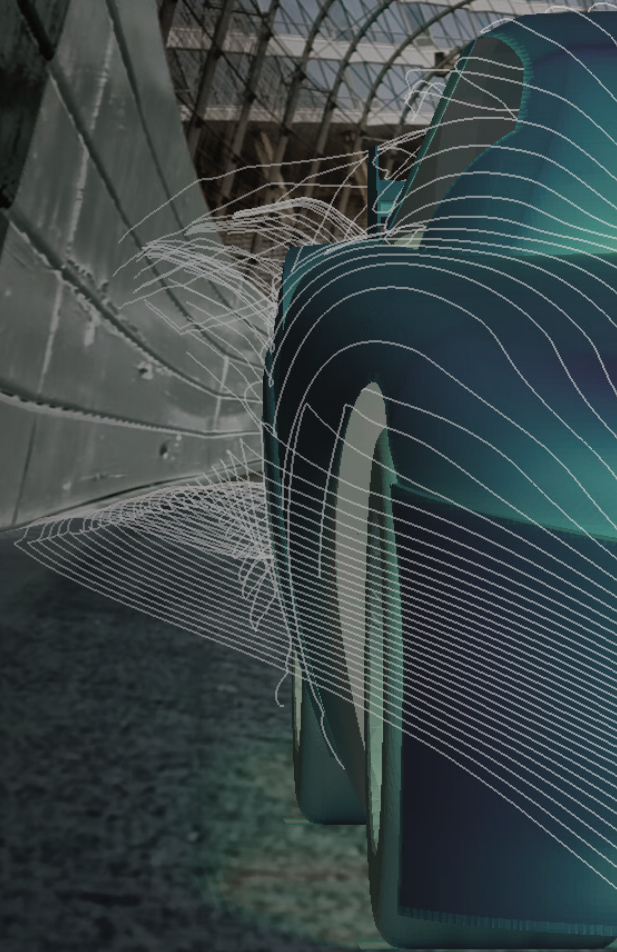
Optimizing a NASCAR Racing Machine

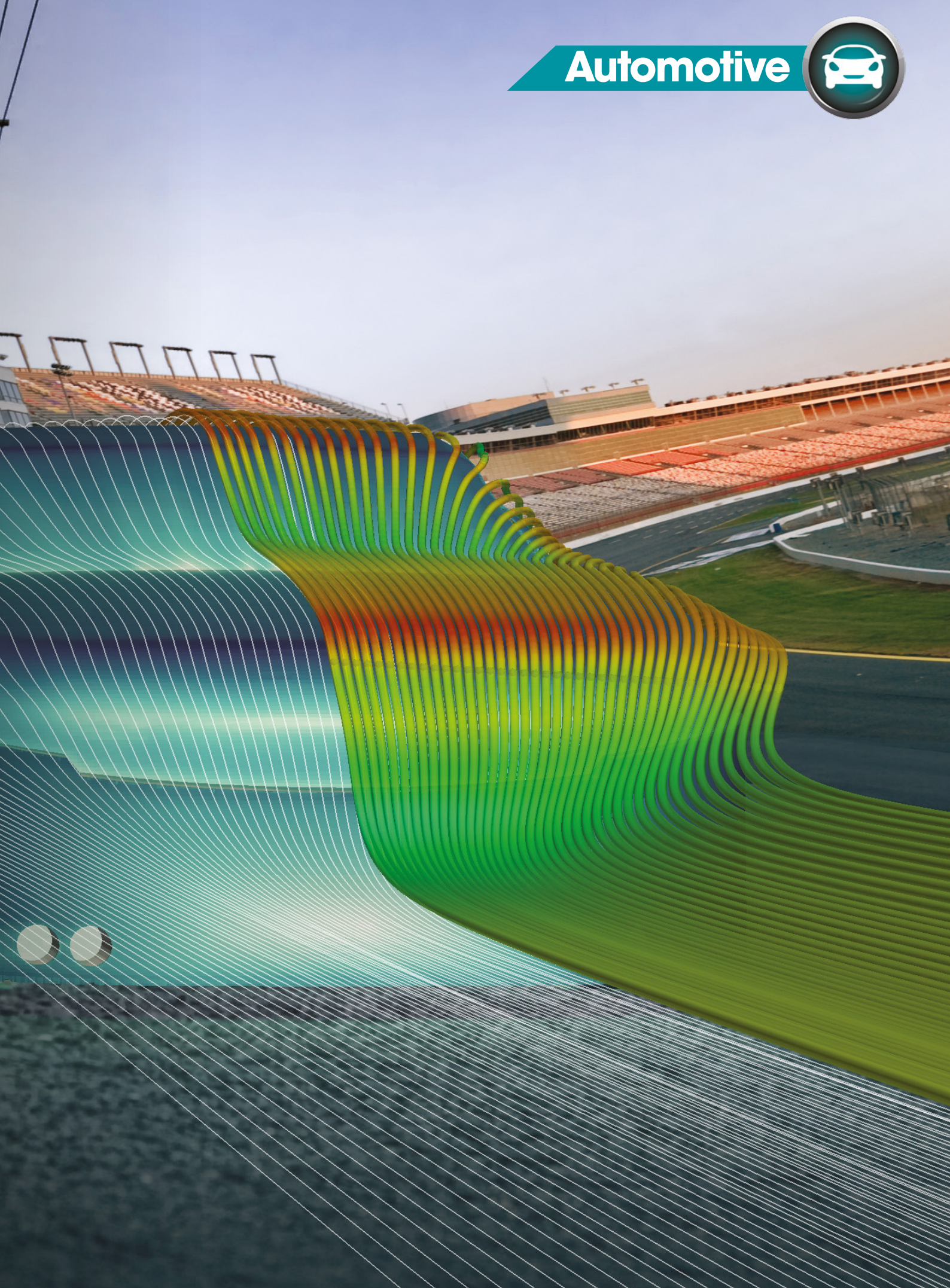
Voxdale collaborate to engineer a champion car using FloEFD

By Mike Gruetzmacher, Technical Marketing Engineer, Mentor Graphics

NASCAR is the most popular motorsport competition in the USA. The three largest racing-series are the Sprint Cup Series, the Xfinity Series, and the Camping World Truck Series. NASCAR sanctions over 1,500 races at over 100 tracks in 39 of the 50 US states, as well as in Canada, and its races are broadcast in over 150 countries.

Initially only modified large scale series vehicles were used for NASCAR. Today's NASCAR vehicles are racing cars with a V8 engine and up to 800 horsepower, but restricted in compliance to the applicable regulations. Only the car body silhouette resembles a series car. The cars are subjected to strict regulations, for example a limited size for the rear spoiler, the chassis material thickness or allowed production processes for the engine cylinders. It is normal practice that winning team cars are dismantled by NASCAR officials after a race to check for any irregularities. The car performances are almost equivalent. There are only a few rare opportunities to gain any technical advantage. This leads to the teams needing to find ways of making small gains wherever they can to improve their performance.





The popularity of NASCAR racing is increasing in Europe, with the NASCAR Whelen Euro Season. NASCAR rules and standards are adopted in the series but the cars are built specifically for European tracks and the horsepower is restricted to 450 hp. One of the most successful European race drivers is Anthony Kumpen from Belgium. He is the overall winner of the 2014 NASCAR Whelen Euro Series season. His huge success in Europe qualified Anthony to compete in the US NASCAR K&N Pro Series East. Today he combines the NASCAR championship in Europe with races in the USA.

We met Anthony Kumpen together with Koen Beyers, CEO of Voxdale BVBA, a successful CFD engineering consultancy, to see what CFD could do to improve their car. Voxdale collaborate to engineer Anthony's team cars using Mentor Graphics' FloEFD.

Anthony explains that there are many aspects to be considered for a racing driver, "There is the driving aspect which is one of the real interesting parts but there are also all the technical details to be optimized. I'm working with engineers and mechanics. There is a lot more than just driving fast in a car. That's what racing is all about. Being a racing driver everybody thinks I spend all the time in the car but actually I spend 80% of my time in meetings with my engineers, with my chief mechanics. Engineering is something we have to study every day in order to be a good driver."

One field Anthony and his team are particularly interested in, is aerodynamics. Since the team does not own or have access to a wind tunnel, like an F1 team would have, they had to find another way to analyze their car's performance. So they teamed up with Koen and the Voxdale team, who are experienced in racing aerodynamics. Voxdale Engineers began working on this NASCAR project by conducting CFD simulations in Mentor Graphics' FloEFD 3D Simulation software.

"The main goal of the partnership was to get insights in the behavior of the car. So when we got involved in the NASCAR project with Anthony the first thing we had to do was to look into what was actually possible to do," Koen Beyers, Voxdale CEO explains.

The NASCAR series is a closed racing series with a very tight rulebook and strict regulations. For instance, the body work could be changed nor could the manifolds or engine parts. Anthony's team and Voxdale decided to analyze the car's aero-mapping and overall behavior. They also investigated the internal flows, the flows underneath the body, and

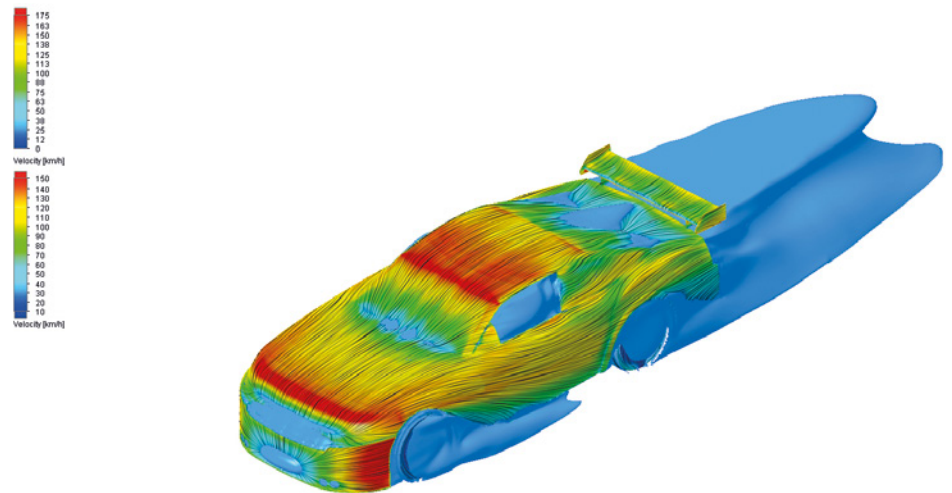


Figure 1. Velocity Streamlines on Body Surface and Isosurface around the Car Body



Figure 2. Anthony Kumpen (left) and Koen Beyers (right)

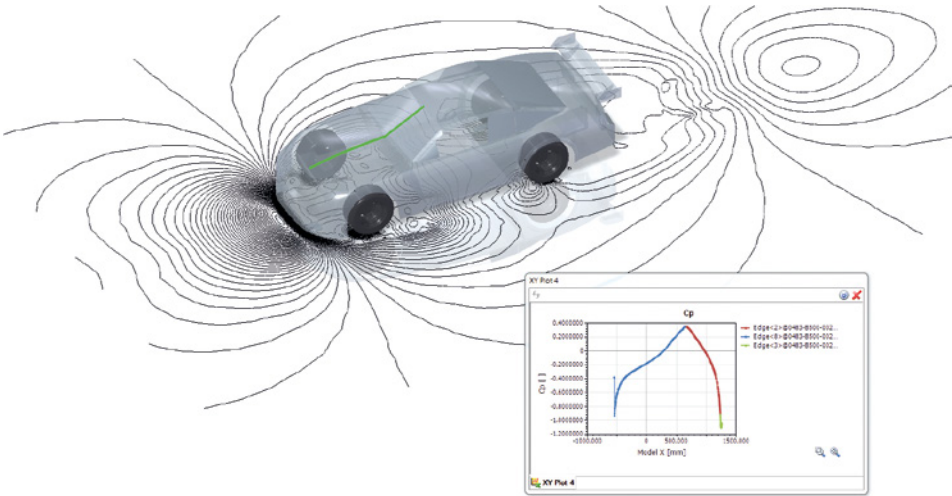


Figure 3. Pressure Coefficient Cp



the hood. Furthermore they optimized the cooling of the brakes and the exhausts. As preparation for the simulations the car model was set up in FloEFD for PTC Creo. The modeling of the geometry took around three days, the FloEFD simulation setup took about a day. The engineers conducted around ten simulations directly within the PTC Creo environment which took about two weeks including post processing. The results of these quickly prepared and evaluated simulations were used for rapid optimizations as the regulations and schedules disallow long predevelopment phases.

“At one point, we saw the effect of a specific riding height combined with an explicit rake angle resulting in a drag reduction of 0.8%. Over one lap at Brands Hatch, with this car with this power, this buys you 0.2 second. An important leap in a closed racing series”, Koen illustrates.

“It is very cool to see the car racing on track, that you analyzed the car and helped the team to give an even better performance” says Patrick Vlieger, Engineer at Voxdale.

“There are a lot of different aspects on aerodynamics that are important for racing. Sometimes you want to have the maximum downforce, sometimes you want to have as little as possible downforce and make the car run really smooth. With all the data the Voxdale engineers gained Anthony's team and his engineers tried to improve the cars on the track and so far it's working really well.” as Anthony confirms.

Anthony Kumpen, “With FloEFD we could do a lot of tests and improvements of the car which helped us a lot. We are winning a lot of races. It's all about the details of racing and finding the right partners and we are really happy to do this with Voxdale.”

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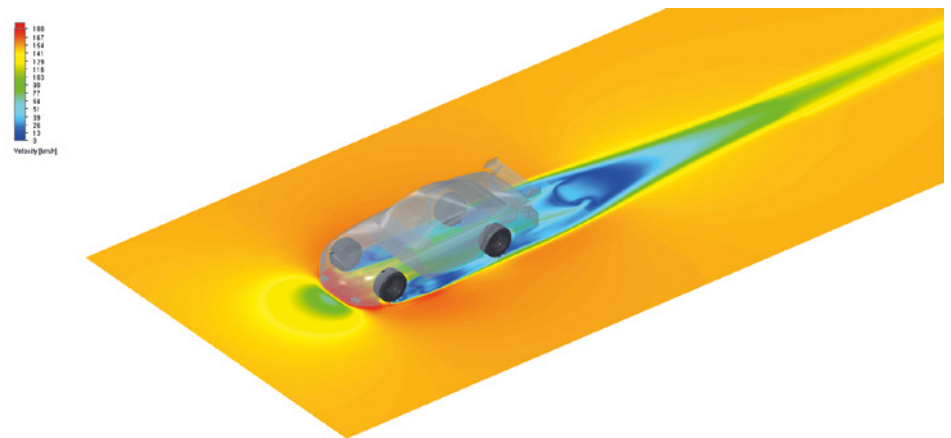


Figure 4. : Velocity Profile underneath the vehicle

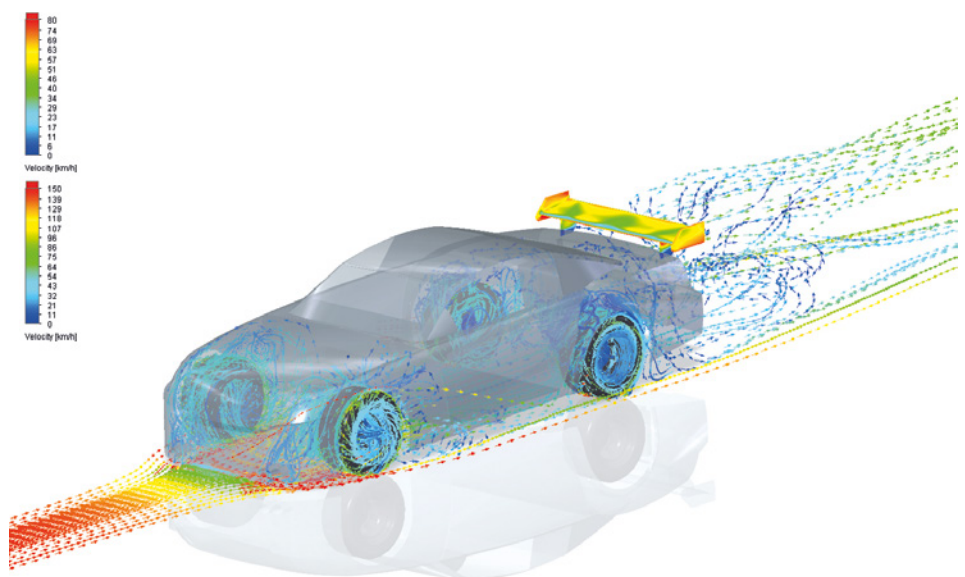


Figure 5. Velocity Profile underneath the Car Body and Wheelhouses

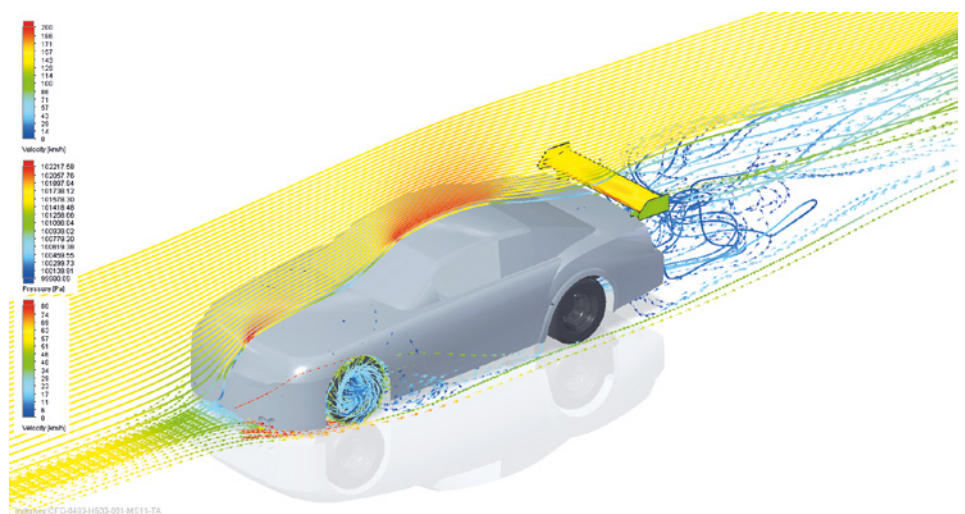


Figure 6. Velocity Profile underneath Car Body and Pressure Distribution the Spoiler