Success Story

McLaren Racing

Getting To the Front of the Grid

"SGI is our high performance partner of choice for CFD supercomputing, and visualization, because we share the same high levels of innovation, strong execution, and desire for a long-term relationship."

– Jonathan Neale, Managing Director, McLaren Racing

Team McLaren Mercedes is one of the most successful teams in the history of Grand Prix racing – an industry where sport meets technology for the business of entertainment. Every two weeks during the racing season, McLaren competes against its fiercest competitors in front of a worldwide audience of 160 million people.

"Formula 1 is a product excellence business that's all about innovation and technology," says Jonathan Neale, Managing Director, McLaren Racing. "We're competing for first place in an environment where the difference between first and tenth is about 0.6 seconds, so we're constantly seeking fractions of a second in performance improvement. On average we'll make a change to the car every 20 minutes during the course of a season, and to do that, simulation is vital in making efficient changes to the car.

"If you look at what differentiates a Formula 1 car, one of the key parameters is its aerodynamics. The car with the driver in it weighs about 600kg, and at speeds over 150mph the car generates enough downforce to be able to run it upside-down. To optimize the aerodynamics we do a lot of design work and track testing, but computational fluid dynamics (CFD) in particular has been an area of major advance for us over the last two or three years.

"Initially we started with very small components – a front wing or brake duct – but we're now running whole car models to see how the integrated car performs. The number of cells we've been working with to solve those equations has also scaled dramatically, so our ability to do 'what if' scenarios in CFD has increased considerably – all of which feeds our need for high levels of innovation."

When McLaren Racing designs a new car, the first step is to understand the limitations of the current car, and develop a solution that will push performance beyond those limits. "The challenge of Formula 1 is that the drive for improvement is relentless," explains Mark Taylor – Senior CFD Engineer. "We're constantly trying to improve the aerodynamics of the wing, floor, top body etc, to get more of the downforce

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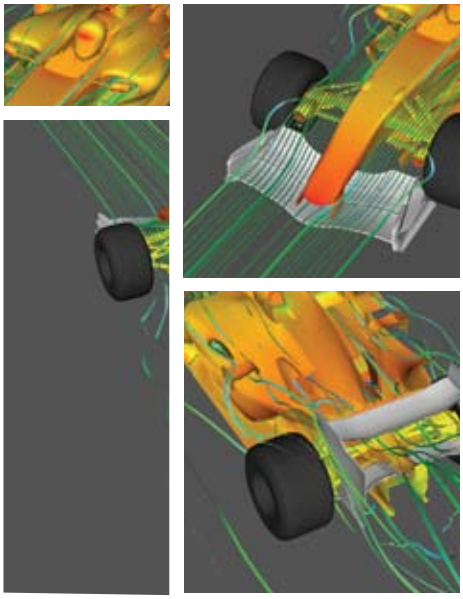
that gives us the fractions of seconds of performance we're trying to achieve. The car therefore evolves throughout the season, and by the end could be 70-80% different to how it started. CFD is particularly helpful for this, by giving us a tool to vizualize a variety of changes we could potentially make, and choose the optimum solution.

"In Formula 1, aerodynamics is the predominant means of increasing performance, so while CFD relates primarily to the body shape, we also look at the cooling for the brakes and engine, and also the engine intake. We often need significantly different set-ups to get the right balance for the car at the full range of race tracks to suit both drivers' styles, and aerodynamics is a very efficient way of achieving this. We've been able to use CFD to develop and deliver solutions very quickly to the benefit of our lap times in both qualifying and the race.

"The beauty of CFD is that it allows us to model scenarios that enable us to get the performance we need in a range of circumstances. The car has to be quick in fast, medium, and slow corners, and in a range of track conditions, and we use CFD to model these and analyze the effects of differing ride height, steer angle, etc. Without CFD we'd have to do this in our wind tunnel, but as this is a finite resource, time we spend fine-tuning the car means we have less time to investigate other ways of making it go faster."

Team McLaren Mercedes has been using CFD for a number of years, like many Grand Prix teams. "What we were looking for from SGI was an ability from our CFD technology to enable us to deliver the contribution to aerodynamics we need to get to the front of the grid," continues Mark Taylor. "McLaren Racing was looking for a partner who could deliver to F1 standards, F1 timescales, and give us the technical expertise we need to constantly improve our aerodynamic solutions. Our evaluation process confirmed that SGI was capable of reaching those standards – and that's exactly what's happened since we've been working together.



"SGI has been able to speed up work involving our full car model many fold. That's of enormous value, because it means there's more coming from the CFD group to increase the performance of the car."

– Mark Taylor, Senior CFD Engineer, McLaren Racing

"One of the unique aspects of F1 is that our CFD models are up to 10x larger than a typical CFD customer. Handling that level of data creates a very difficult logistical problem, so we wanted to be able to go from CAD to final post-processing with as little input from the CFD engineer as possible. This is a key area where SGI, through their ability to understand technically what we were trying to do, gave us a total solution that achieves it. The challenge was to have a computer capable of handling very large models, tightly integrated with high speed graphics rendering, and SGI was able to deliver that."

The solution selected by McLaren Racing includes an SGI® Altix® supercomputer, Silicon Graphics Prism™ visualization solutions, InfiniteStorage and CXFS™ shared file system. When a CFD engineer needs to run an analysis, the CAD model on which this is based is transferred from one of the graphics workstations on which these are prepared, to a Prism where it is turned into a computational mesh. Once the mesh has been built and the model set up, the job is submitted via an automatic queuing system to the Altix. When the solution is returned, this too is automated, with a post-processing script being run to turn the computational results into images the engineer can view to judge the aerodynamic improvements he or she has made, how these can be further manipulated etc.

"The big step forward is that our CFD engineers can now really focus their efforts on getting the geometry right, and then on the results," says Mark Taylor. "We estimate that by automating much of the process in-between, SGI has been able to speed up work involving

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our full car model many fold. That's of enormous value, because it makes the engineer available for the next design or improvement, and means there's more coming from the CFD group to increase the performance of the car.

"The fact that SGI has the detailed hardware and software expertise to deliver such a powerful solution really has contributed to this; and looking to the future, CFD will play an increasing role in how the car looks, how it performs, and its aerodynamic performance. That will enable our engineers to have more and more impact on the performance of the car, and that will mean winning races."

"What makes a Formula 1 business successful is high levels of innovation and very slick execution. We need to generate and evaluate ideas very quickly, and there's no room for error at the end of the delivery process. You just can't be 15 minutes late for a Grand Prix. What we found when we started talking to SGI was that they had that mix of high levels of innovation; they're in it for the long term, and they were going to give us the level of execution we need," concludes Jonathan Neale.

"If we look at what's happening in Formula 1, then for a whole host of reasons, including cost reduction, testing is becoming increasingly difficult. What this means is that there will be more and more reliance on simulation. Formula 1 is a high technology, innovative business. McLaren Racing is at the forefront of that, because we are a high performance organization – as racers. SGI, meanwhile, is our high performance partner of choice for CFD supercomputing and visualization, because we share the same high levels of innovation, strong execution, and desire for a long-term relationship. And in that respect, both as a product and a value set, there's a very good match."

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Itanium 2 inside

Corporate Office
1500 Crittenden Lane
Mountain View, CA 94043
(650) 960-1980
www.sgi.com

North America +1 800.800.7441
Latin America +55 11.5509.1455
Europe +44 118.912.7500
Japan +81 3.5488.1811
Asia Pacific +1 650.933.3000

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