HONDA RACING F1 TEAM

SUCCESS STORY

Jenson Button, 2007 Belgian GP, Spa-Francorchamps, Belgium, Pitlane. Courtesy of HondaRacingF1.com

SGI® Altix® ICE "In a League of its Own"

in Supporting Honda's Environmental Approach to Formula One Racing

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Honda has a rich racing pedigree in many different types of motor sport, and its acquisition in 2006 of a 100% shareholding in the team formerly known as BAR Honda underlined its commitment to rediscovering its winning ways in Grand Prix racing.

The team made its Grand Prix debut in 1964, when it raced a single car in the German, Italian and US Grands Prix. The following year it celebrated its first world championship point at the Belgian Grand Prix, and also its first win – in Mexico – both thanks to the American driver Richie Ginther.

Honda's next victory was by John Surtees in the 1967 Italian Grand Prix – a season in which the team secured fourth place in the constructors' world championship. Following title successes as an engine supplier during the '80s and '90s, the highlight of Honda's return as a works team in 2006 was Jenson Button's victory in the Hungarian Grand Prix, which helped secure fourth place in the final constructors' standings.

To date (September 2007), Honda has amassed 72 Grands Prix victories and 11 FIA Formula One World Championship titles – including six constructors' and five drivers' crowns. This is a record that all involved in the Honda Racing F1 Team (based in Brackley, UK) are determined to add to in the future.

CFD Improvements Drive Faster Lap Times

"Formula One is a fiercely competitive business where fractions of a second could gain you ten places on the grid, and where

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Rubens Barrichello, 2007 Italian GP, Autodromo Nazionale di Monza, Monza, Italy, Grid. Courtesy of HondaRacingF1.com

Path-lines released upstream of the front wing showing the general flow of air around the vehicle. Courtesy of Honda Racing F1 Team.

the overall rate at which you can develop your car means the difference between winning and ending up outside the points," explains Henrik Diamant, Head of CFD, Honda Racing F1 Team. "The drive for performance is relentless, and with the current technical regulations, aerodynamics is the key area where crucial lap time gains can be made.

"Traditionally, aerodynamic development has been conducted in wind tunnels, but with recent advancements in CFD codes and supercomputers, an increasing number of race car parts are developed directly in CFD, saving both time and costs.

"Although we've been running large, complex, complete car CFD models at the Honda Racing F1 Team for a number of years, it's only recently that software developments have truly revolutionised the process. For example, five years ago, generating a CFD model of the complete car would have required weeks, whereas with today's largely automated tools our engineers can create a model in a few hours. Needless to say, with such an increased throughput, the limitations on the number of models or parts we can analyse depend on the hardware used to solve these very complex calculations."

A Honda Grand Prix race car generally has in the region of 10,000 Honda-designed components (including all the minor parts such as nuts, bolts, washers etc), and a further 13,000 parts that Honda is not allowed to change due to the rules of Grand Prix motor racing. The engine, for instance, is homologated for three years, meaning it will be the end of 2009 before there is another change. The gearbox the team starts the season with will also receive only minor alterations unless there is a major problem or advance in technology. And the structure of the monocoque in which the driver sits is also unlikely to change during the season.

But apart from these, virtually any part can – and will – be developed and improved over the course of the season. As a result, during the year around 30,000 parts will be drawn by the team's aerodynamics specialists, and a further 20,000 by the drawing office. "If you look at the geometry of the race car aerodynamically, the car we finish the season with is completely different from what we start with. There is no commonality. The front wing. The rear wing. Everything is different," says Henrik Diamant.

Contributions Throughout the Development Process

To assist with the aerodynamic development of its cars, the Honda Racing F1 Team's CFD department used a number of home-grown 'white-box' clusters. Part of the reason for this was that prior to Honda's purchase of the team, the department (which also undertook work that was not directly related to Grand Prix racing) was expected to be self-financing, and the clusters were a very time- and cost-efficient means of providing the compute resources required.

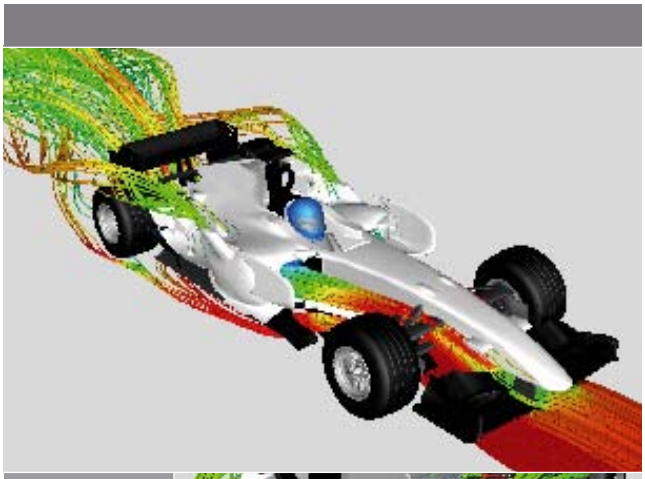
"Following Honda's takeover of the team, the CFD department's focus has moved purely onto the performance

SGI® Altix® ICE "In a League of its Own"

development of the Formula One car," explains Matt Harris, Technical Infrastructure Manager, Honda Racing F1 Team. "As a result, what we are interested in is pure turnaround – what we can get through the CFD department as quickly as possible. And one of the first major bottlenecks we identified was our compute resource."

The way the CFD department's development process works is that generally when an engineer suggests an idea for improving the car, the relevant geometry is generated using a CAD workstation. The meshed CAD part is then fed through an automatic meshing process, which is where (historically) the biggest gains in the speed-up of the process have been made. The CFD model is then solved and the results output automatically, so that the engineer can go back and analyse the data on his or her workstation.

"Our contribution to the overall development process is very broad-ranging," says Henrik Diamant. "Some of our work is conceptual, where we analyse big modifications to the car and need to visualise the air flows to see where the greatest potential gains may come from – in which case we're effectively leading the development process. But we also work on fine-tuning the geometrical detail as part of an automated process, in which case we're one of the final stages in the process.



Top: Streamlines coloured by pressure, showing the extent of the wake structure behind the car. Right: Streamlines highlighting the airflow through the radiator cooling system. Courtesy of Honda Racing F1 Team.

"With our existing installation we were able to analyse a couple of dozen different geometries per week. We had recently speeded up our CFD process to such an extent that our biggest bottleneck was the hardware, which is where SGI and the SGI® Altix® ICE have come in."

18% Faster Benchmark Performance

Having been given a budget by Honda to increase the speed of its development process, the CFD department undertook an extensive survey of the available technology to identify the optimum solution. "It quickly became clear to us that for the same number of processors, the performance of the SGI Altix ICE system was in a league of its own," continues Henrik Diamant. "In fact, we were absolutely amazed when we benchmarked two systems of what would appear to be an identical specification and noted that our CFD calculations ran 18% faster on the SGI Altix ICE. For us that means places gained on the grid!"

Altix ICE is SGI's next-generation integrated blade platform offering breakthrough performance density, breakthroughs in power/cooling and breakthrough reliability. Based on Dual-Core and Quad-Core Intel® Xeon® 5000 Processors and the Linux® operating system, Altix ICE offers an integrated blade architecture (including InfiniBand interconnect and software), high-end scalability, and advanced reliability and density features.

In September 2007, the Honda Racing F1 Team took delivery of a high-performance Altix ICE, which it expects to make a significant impact on the contribution provided by CFD during the 2008 racing season. "With Altix ICE, the

"The Altix ICE solution with its built-in water cooling and power efficiency is one of the best in class for power and performance."

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Jenson Button, cockpit, pit garage. Courtesy of HondaRacingF1.com

number of complete vehicle CFD models we'll be able to process could increase by a factor of five, which is key in adding performance to the car," says Henrik Diamant. "If we can increase our weekly throughput of parts analysed, then we can find those fractions of a second that could ultimately give us an edge against the competition.

"The more parts we can analyse, the more performance improvements we're going to be able to add to the car. And, by increasing the number of parts we're able to analyse in CFD, as well as different racetrack conditions, we should also take some of the load off the number of parts that need to be tested in the wind tunnel, and so enable our colleagues in that department to focus more on the areas that are perhaps better suited to wind tunnel testing."

Supporting Honda's Commitment to the Environment

Although the outstanding performance of the Altix ICE was an important factor in the system's purchase, it was not the only one. One of the Honda Racing F1 Team's key objectives for 2007 is to raise awareness of environmental issues through the team's distinctive 'Earth Car' livery, and the myearthdream.com website on which visitors can both learn about the environment and make a pledge to change a part of their lives to help it. Since Altix ICE is one of the most energy-efficient platforms per processor core, the system therefore had a very good match with the achievement of this objective.

"The Altix ICE solution with its built-in water cooling and power efficiency is one of the best in class for power and performance and provides a two-fold improvement on the power and performance of our previous system," explains Matt Harris. "Even though the throughput of the system could increase by a factor of five compared to our old hardware, and it has a large increase in the number of processor cores, the Altix ICE uses only two-and-a-half times the energy of the previous system, so we're trying to make it as environmentally friendly an implementation as possible. Also, because Altix ICE has a diskless architecture, its reliability is unparalleled compared to other systems. And despite being advised that this would result in performance degradation, it's actually proved to be the complete opposite."

"We saw a range of alternative suppliers, and out of all of them, SGI came back with what we felt was the most comprehensive and convincing technical solution. They had a unique awareness of our requirements, and immediately understood what we needed," concludes Henrik Diamant. "SGI were one of the only people who really thought about what the future might mean to us with our increased compute power – in terms of workstations, storage, model size, our future requirements, future growth, what we might need to do, and how the SGI system could scale and help us as a complete solution. So overall, choosing SGI as our partner for supercomputer solutions was one of the easiest decisions we've had to make this year!"

Jenson Button & Rubens Barrichello, 2007 Turkish GP, Istanbul Park, Istanbul, Turkey. Courtesy of HondaRacingF1.com

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