The International Journal of Motorsport Technology

Racecar engineering™

FREE RACECAR MANUFACTURING SUPPLEMENT INSIDE

June 2009 • Vol19 No6 • www.racecar-engineering.com • UK £5.25 • US $9.99

LOTUS vs LOTUS WORLDS APART
Exige Speed World Challenge car and 2-Eleven GT4 investigated

DAVE WILLIAMS CHASSIS GURU
Multimatic rig master on the subtleties of vehicle dynamics

TORSION BAR TUTORIAL
Understanding the applications of this alternative spring

ACURA LMP1
F1 INSPIRATION FOR GROUNDBREAKING SPORTSCAR

OFF SALE DATE 12TH JUNE

PERFECT 10s

A company in Mooresville is now offering race teams a way to get the perfect Stock Car body time after time

In a racing class as close as Sprint Cup, precision matters. With 43 cars crossing the start / finish line in just a handful of seconds it has to. But on hand built, panel-beaten cars that share a design ethos with a 1950's truck it's not always that easy to achieve.

Laser scanning is nothing new in Europe – you see it in use almost daily in a mind-boggling range of applications, including archaeology, tunnel monitoring, reverse engineering and espionage, but its use in motor racing is less common. Initially, it found limited use in Formula 1 but, as the technology became cheaper to buy, Formula 3 and racing saloon teams started to hire freelance scanners to try to get that extra edge. In NASCAR, however, until very recently, this technology has been the preserve of the very top teams only.

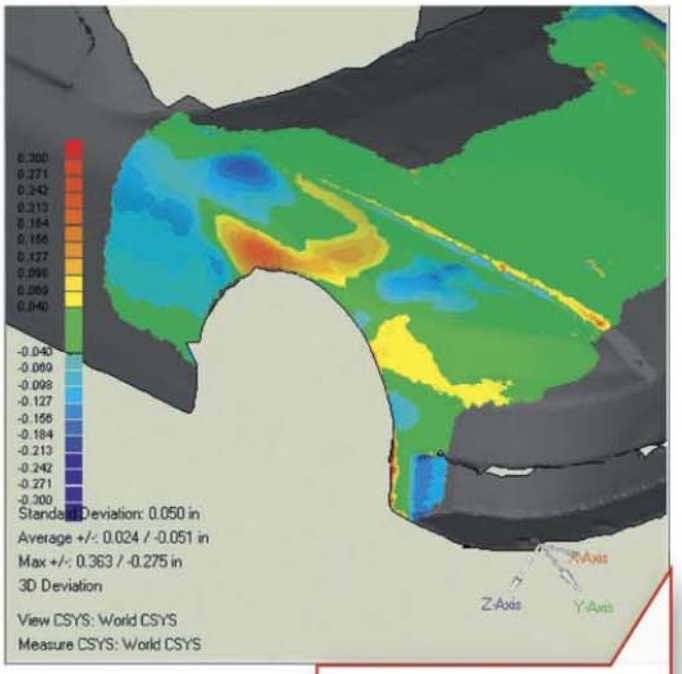
In early 2008 a team went to the Aerodyn wind tunnel in Mooresville as part of its Daytona 500 preparations to run back-to-back tests on apparently identical cars. They were staggered and confused to find 15lb difference in drag between them and, as a result, turned to two representatives of Z Corporation in Mooresville, NC – Kevin Outz of Matrix CAD Design and Bill Watson of Anvil Prototype. 'They should not be that far apart, but the team did not know where the difference was,' explains Outz, 'so we came in, scanned the cars and overlaid the data onto a model that allowed the team to visualise with the colours where the dimensional differences were. They could then go back and change the body panels to improve the car's performance.

> **Digitising the cars' bodies makes performance more repeatable**

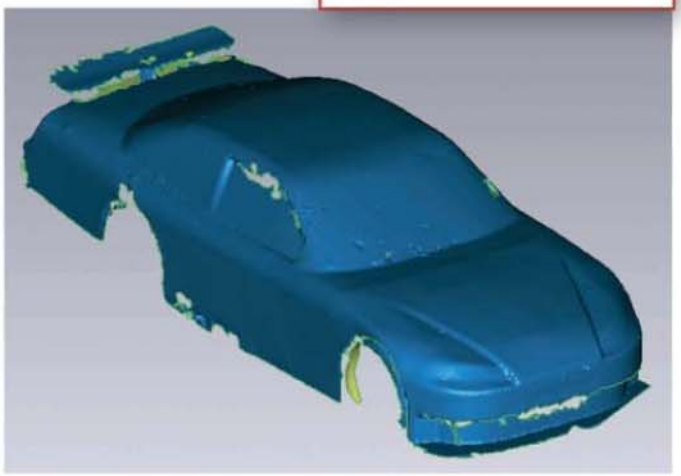
'The models we did for them varied in ranges. With our kit you can set your tolerances and colour spectrum to see as small as 5000th or even 1000th of an inch, but typically they wanted to see every 30,000th of an inch (1/32nd of an inch on a tape measure). They are more likely to hold about a 16th of an inch to hand work sheet metal as you just can't get to a 32nd, but they still wanted to see it in increments of 30,000th of an inch.'

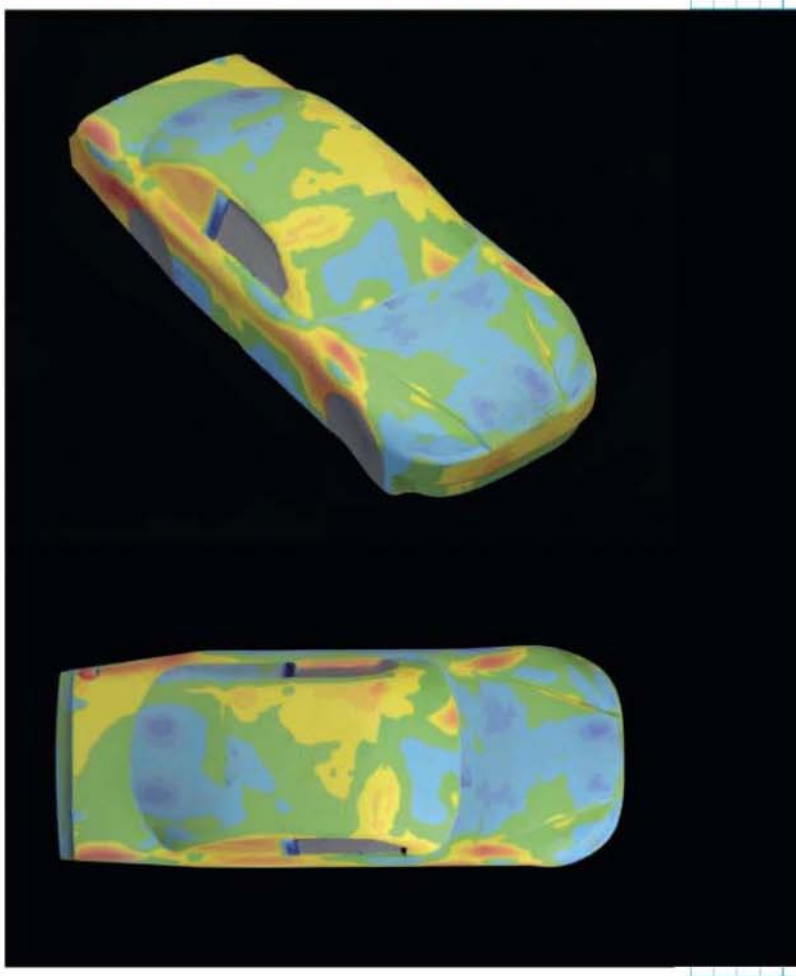
These models allowed team engineers to guide the panel beaters with an unprecedented level of precision, but transferring this technology to the guys doing the work had to be done in logical iterations. 'The way we started was just with two-dimensional

HARDWARE
Z corporation produces both the printer (main) and scanner (inset)



SOFT SHEET METAL
The raw scan (below) can be used to make a hieght map





SAVING TIME AND MONEY

Compared to Formula 1 teams, Stock Car teams have tiny budgets, yet are equal in their levels of ingenuity. Some of the larger Cup teams have invested in millions of dollars of high-end rapid prototyping equipment, but now lower cost printers are hitting the market and making the technology available to all.

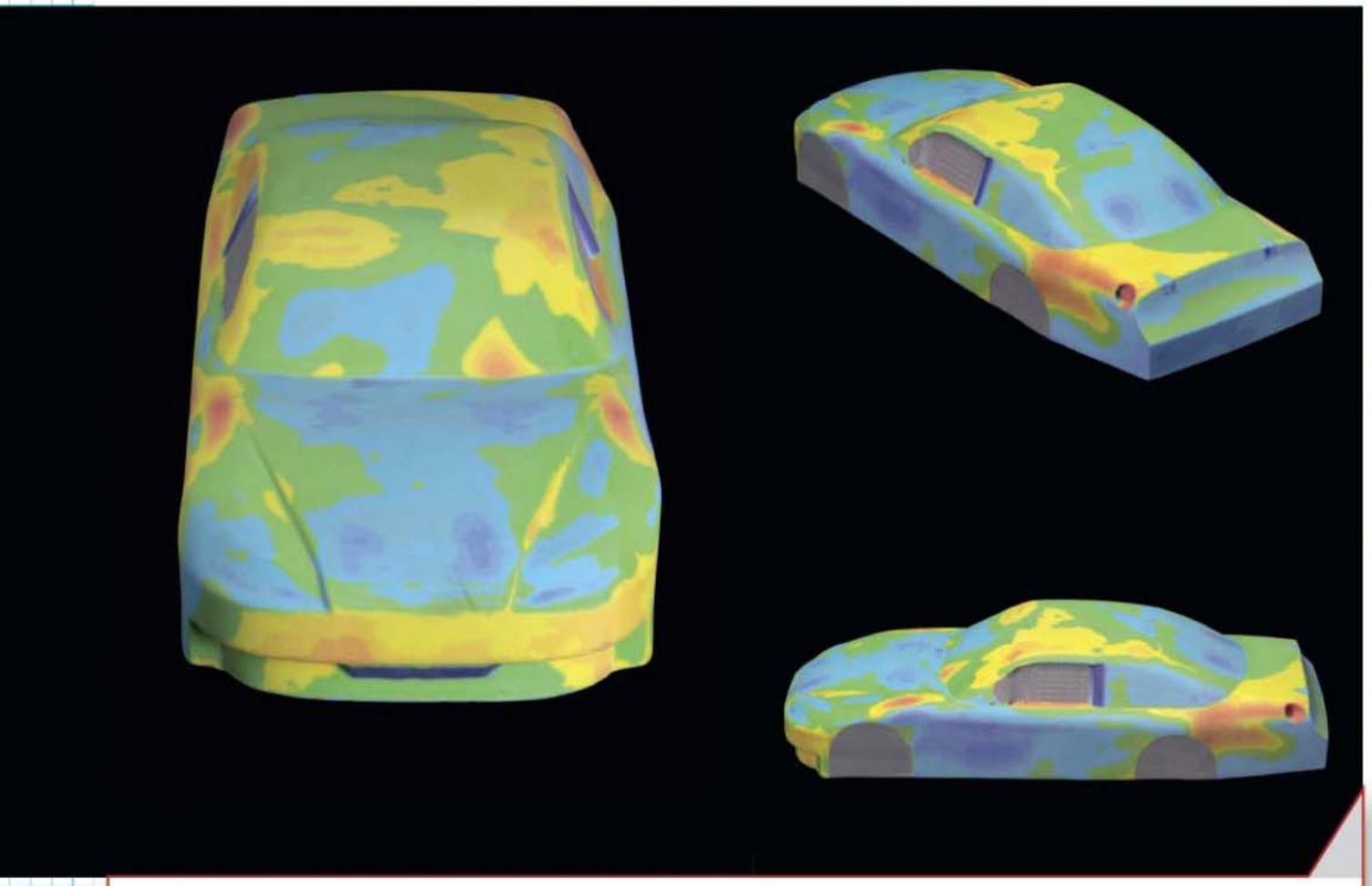
'A piece of equipment that is only $40,000 (£27,000) can now be 10 times as fast at a 10th of the price,' claims Bill Watson of Anvil Prototype. 'It allows us to do a lot more parts quickly and, when we are talking about the larger teams that already have SLA equipment, we can generally clear a week-long backlog on an SLA in a weekend. You take the parts that are massive and take a long time on the expensive equipment and use the less expensive equipment to clear the backlog. This means you can ensure that the critical surface finish parts can be made on the high dollar equipment faster. It also helps you design and prove parts faster. If your engineers are having to wait for parts, then there is a bottleneck and those are vital days between now and Daytona that you have wasted sitting around waiting for parts.'

paper reports, because the sheet metal fabrication guys were not used to seeing three dimensions in a two-dimensional layout and initially there was some confusion. That sparked the interest in taking the CAD file with some colour in it and rapid prototyping it to help as a communication tool. That's how the combination of both products came about,' explains Outz.

These models allowed the fabrication shops to figure out how to manipulate the surfaces to the maximum degree allowed within the rules. 'You do have some play between the templates, even with the 'claw', so you can improve on that gold standard version, which is legal but only average. But racing is not about being average, it's about winning. Using the models allows the guys to make the cars quicker.' Digitising the cars' bodies makes the cars' performance more repeatable, too. 'If you win Daytona you better know exactly what that car looked like, so you can repeat it,'

When NASCAR introduced the 'claw' template, along with the CoT, it was meant to stop a lot of the manipulation of the grey areas between the templates but, as Outz explains, there are still areas that can be optimised. 'You have 15-18in between each cross section, and within one of those you have the gap right behind the front tyre well area, or the c-pillar. That's a really shaped area, not a flat panel that's easy to change and work to the desired shape. There are a lot of differences in that area but, until now, teams could not dimensionally check and know where they were. Having digitised bodies lets them do just that.'

One of the areas Outz and Watson pride themselves on is the speed and ease of using this technology – both the scanner and the 3D printer are cost effective and fast. 'We are known around here for being able to do the fastest



VISUALISING DIGITAL REALITY
Once the car has been scanned and a height map produced, with red denoting high areas and blue low, the model can be created using the Z-Corp 3D printer. Some teams have found that using these models to communicate with the sheet metal workers highly effective.

full colour rapid prototypes, which is the fastest way to make a solid model and is key for racing – it's all about speed and designing things faster. We are about 10 times faster than the FDM process, two or three times faster than traditional SLA and about 10 times faster than SLS. For us it is more of a do-it-yourself design aid that helps people get parts in their hand or into the wind tunnel quickly.'

SELF-POSITIONING

The Z Corporation scanners used by Matrix CAD Design are claimed to be the only ones that are truly hand held and portable. 'There is no expensive tripod or portable CMM arms to attach to it. It's unique because it is self-positioning, which means it references the part for its position, so it allows you to rotate the part as you are scanning it. We have even scanned cars as they are being built in the workshops.'

It takes eight to 10 hours to scan a whole Stock Car but, according to Outz, that's not time when the car is out of action. 'We don't tie up the surface plate and we don't tie up the car whilst we are scanning. A mechanic can come in, undo the window net and get in the car and it doesn't matter. You can even be rolling it across the garage floor when you are scanning. You can scan the fender straight after they hang it on one side whilst they're still hanging the other side – that way you can tell the body guy before it is too late if it's out [of shape].'

> "30 minutes of training and you are up and running"

The scanner outputs in a .stl format, which can be fed straight into CFD software or a 3D printer with very little post-processing needed as it already has a polygon mesh, rather than just cloud points.

Of course, as with many new technologies, it all sounds horribly expensive, but there's the next surprise. Teams can hire the scanning outfit to come to the race shop and scan a car for around $2500 (£1700) for data collection and comparison against another scanned surface. What this means is that it's now a realistic option for Nationwide and even Truck teams. In practice, Outz and Watson generally try to persuade teams to buy in their own equipment so they can get a handle on it themselves and because they are not always available, such is the demand for the service.

'Five years ago you needed to have a million-dollar budget to do scanning and rapid prototyping. Now we are talking in the region of $100k (£67,500) and you have the full thing and are ready to go. You don't have to be an engineer to know how to use it either – 30 minutes of training and you are up and running,' says Outz enthusiastically. As if to back this up, teams have been clamouring to buy the kit already and Outz is brimming with confidence for the season ahead: 'The teams that do it are gonna win races,' he says. 'We are very excited about a couple of clients in particular that we are working with and we expect them to be winners this year because they are using this technology. The folks that don't have it are gonna lose races because they are missing out...'