Advanced Circuit Driving Techniques

VBOX MOTORSPORT

Brain Power is the new horsepower

This guide is made up of articles written by pro racing drivers and instructors who use video and data to illustrate various circuit driving techniques, with tips on how to get the most out of yourself as well as your car.

Some may surprise you...

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RACELOGIC

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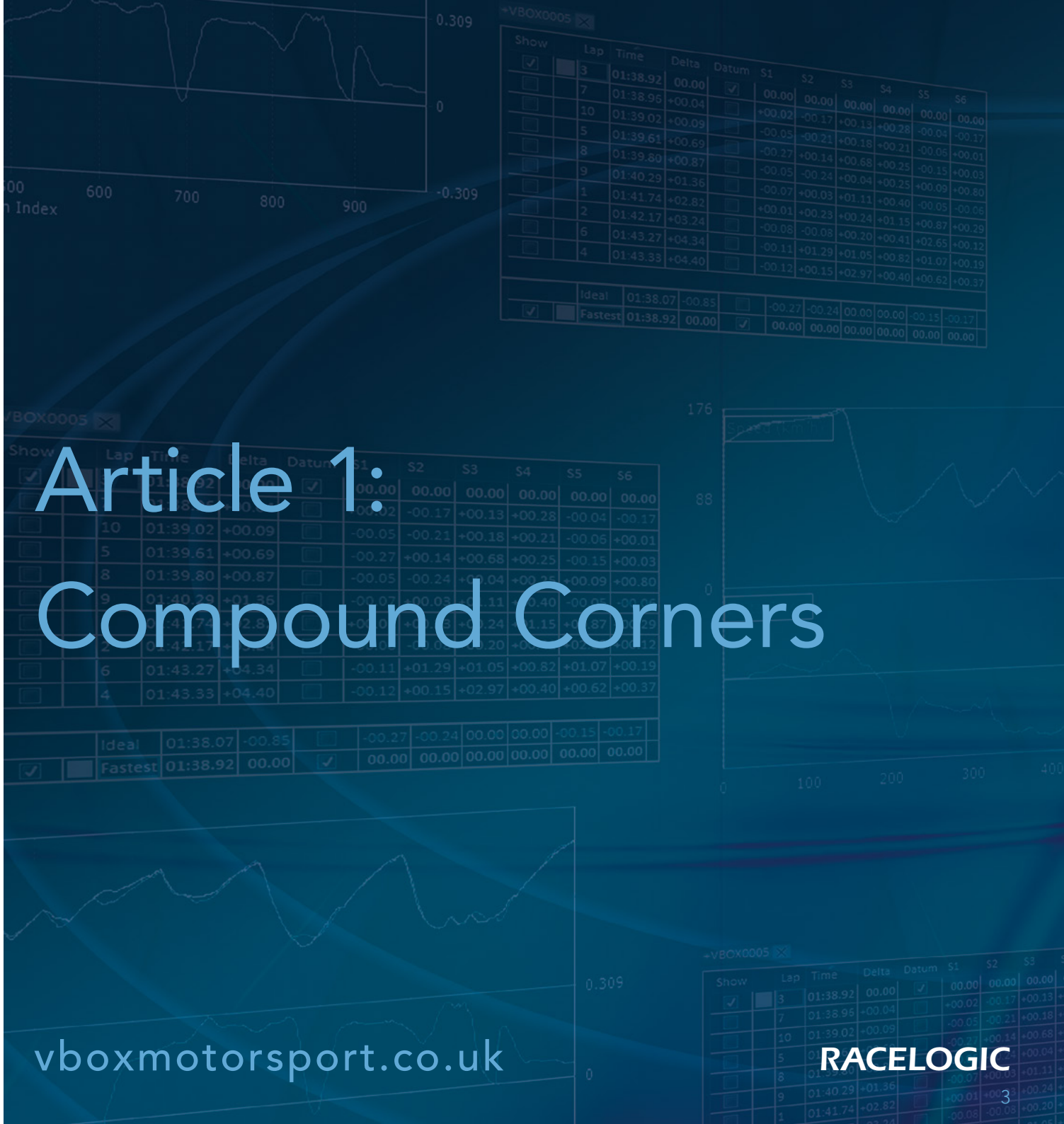

Article 1: Compound Corners

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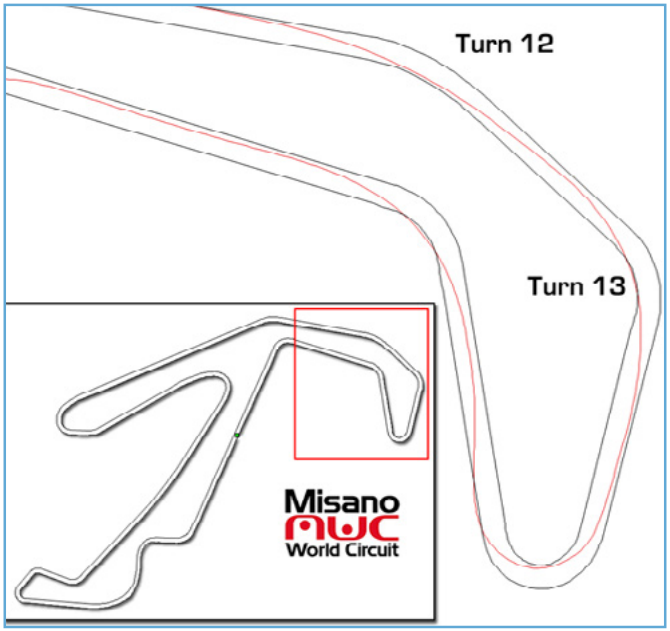
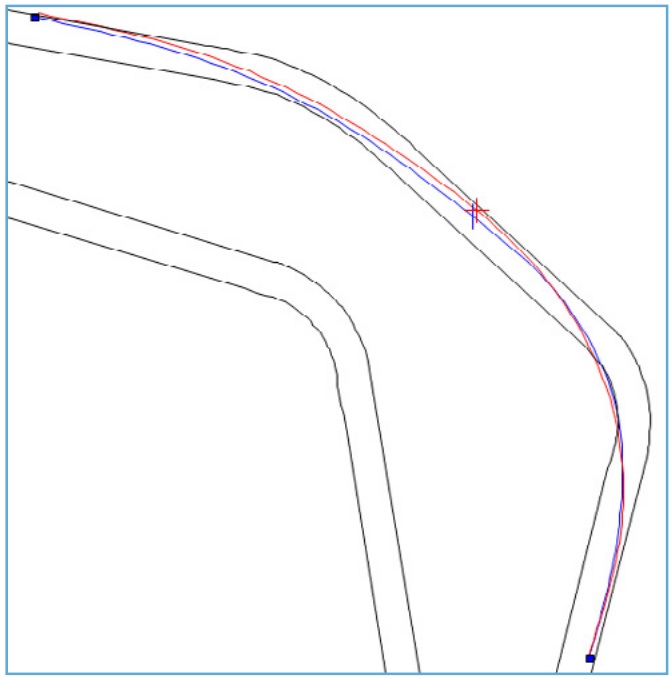
Definition – Compound corner: a series of corners, close enough such that the car is always turning and never travelling in a straight line.

Nigel driving in the Funcup Misano 2009



Misano World Circuit



Two different lines

The following data was taken from a Funcup race at Misano in 2009.

Nigel Greensall – "It is a common mistake to treat compound corners as two separate items, whereas they should be tackled as one section, with sacrifices being made in the first corner to gain maximum exit speed. It often seems counter-intuitive not to maximise the speed through the first corner, but the end result is often a faster lap.

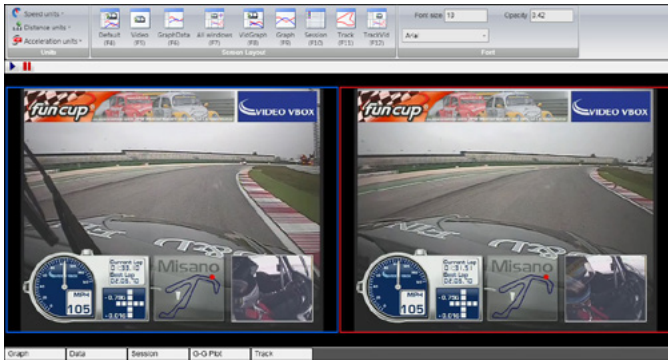
There are many examples, but let's take Misano Circuit which is shown above, Turns 12 and 13 which consists of a shallow right hand corner followed by a sharper right hand corner.

On first inspection you may naturally assume that you have to clip apexes of both Turns 12 and 13 to get the best lap time.

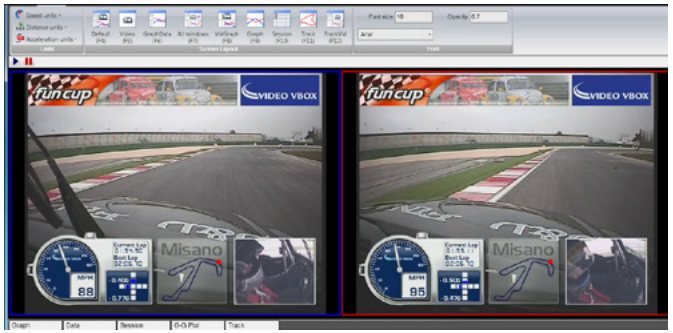
However, there are many other ways to take these corners and I have found that the quickest for me is to almost ignore Turn 12 by missing the apex completely, and set yourself up for a nice wide entry into Turn 13, which seems a little odd at first.

To see this line in action, have a look at the image above, which shows my preferred line in red, and my team mate's line in blue.

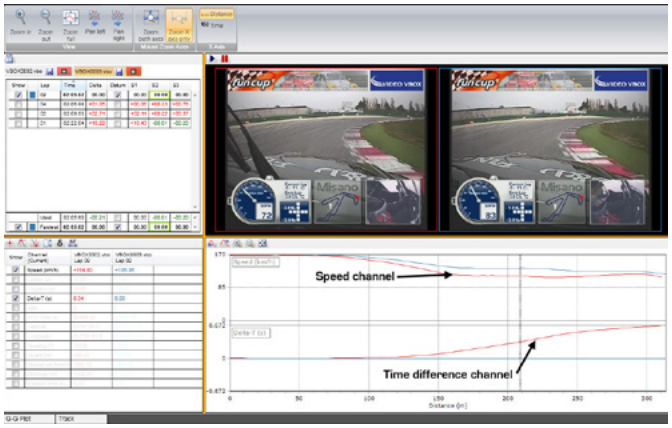
The red line misses the apex of Turn 12 by almost 2m, but maintains the same apex speed of 105mph as the blue line which clips the apex.



Different line, identical Apex speeds



Much wider entry into Turn 13



Analysing Apex speeds at Turn 13

Interestingly, through Turn 12 you are not quite on the limit of grip (a peak of 0.85G), so you can experiment with your lines through here without losing any speed.

This wider line is also slightly shorter, which also gives a small advantage.

The screenshot above shows the apex point of Turn 12, where both approaches have the same speed, 105mph.

It is after this point where the reason for this wider line becomes clearer.

If you treat Turn 12 as a conventional corner and clip the apex, you cannot get far enough across to use the whole width of the track into Turn 13.

By running wide in Turn 12, you can get much further over to the left for the entry into Turn 13 allowing more speed to be carried around the corner.

Using more screenshots from the in-car video, you can see just how much closer to the edge of the track (just before Turn 13) I could go, whilst carrying 7mph more speed.

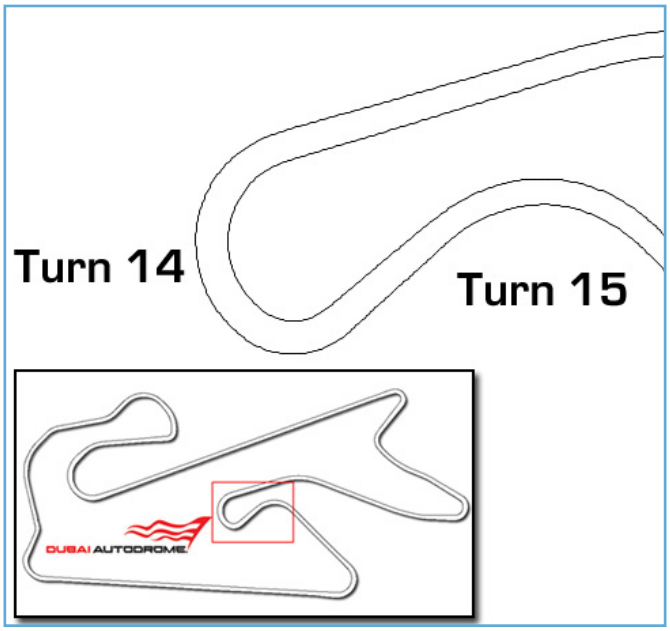
If we look at the Apex speeds of the second turn using **CIRCUIT TOOLS** software, the gain in speed is even greater.

In this screenshot you can see that the wider line allows me to carry 11mph more at the Apex, the upper graph is the speed, and the lower graph is the Delta-T or time difference between the two laps.

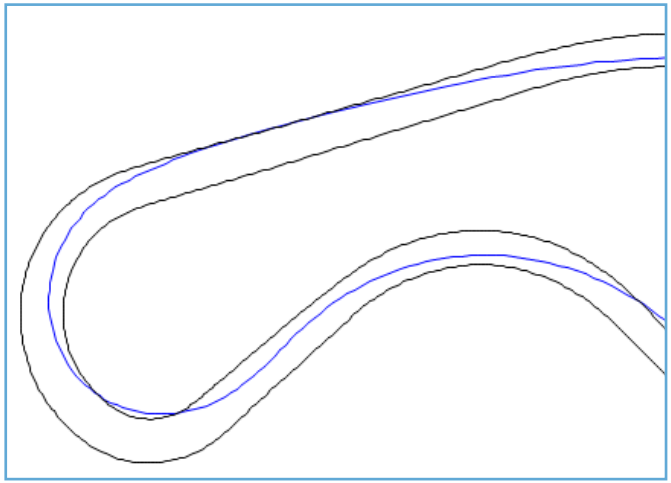
The analysis software showed a total gain of 0.67s in this section, which was very simple to achieve, just by taking a slightly wider line through Turn 12, which is very easy to do!"

We now zip 2700 miles across to the Dubai Autodrome in an Aston Martin GT4...

Nigel driving in the Dubai 24 Hour race in 2010



Dubai Autodrome


Conventional line

Nigel Greensall – "Here's a great example of a compound corner, Turn 14 (Parabolica) and Turn 15 on the Dubai Autodrome GP layout.

This is another example of where you need to think of them as a whole rather than as two separate corners.

Turn 14, the Parabolica, is slightly banked, and being a desert circuit sand tends to drift across and collect on the outsides of the track.

There is only a very short straight before Turn 15 and this is the reason why you can take an unusual line through and compromise the Turn 14 slightly to gain an overall advantage.

If you attack Turn 14 as a conventional corner, you may start off wide and sweep in for a late apex to maximize your exit speed. This is in fact the line that the race school teaches you.

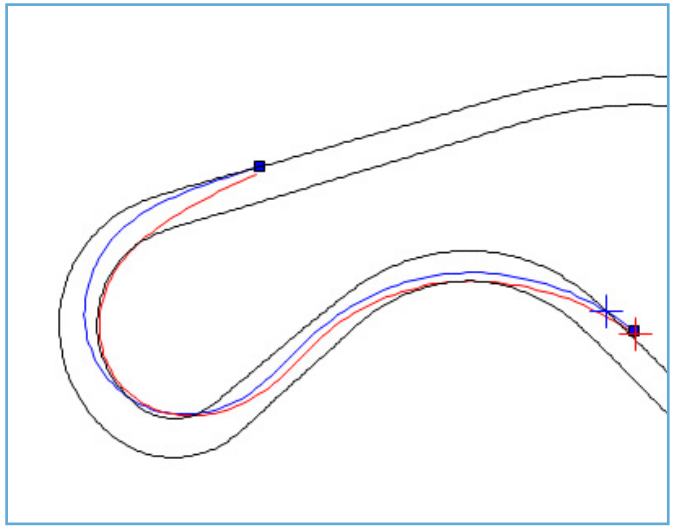
This would probably work fine if there wasn't another corner straight afterwards.

This second corner means that the exit speed of Turn 14 is not so important, because you can't carry this extra speed down a long straight.

If there wasn't a corner straight afterwards, then you may take the conventional line to gain the maximum corner exit speed which would be carried all the way down the straight.

Because there is no long straight after Turn 14, what becomes important is getting to Turn 15 as soon as you can, so in this case it is better to take the shortest route possible and take a very tight line around the Turn 14.

This has the added advantage at this track of missing out on the sandy outer edges of the track.



Two different lines

This seems as though you would lose a lot of speed going round Turn 14, and indeed the wider line has an apex speed of 89km/h (55mph) compared with 79km/h (49mph) for the tighter line. Yet this line is **0.45s** quicker, which is very counter-intuitive!

However, the reason this works is the really interesting part; the tighter line is **13.9m (45feet)** shorter than the blue line, so even though the blue line had a higher average speed, the significantly shorter distance has a pronounced effect and in this example gives a 0.45s advantage between the entry to Turn 14 and the exit of Turn 15 and the exit speeds are almost identical.

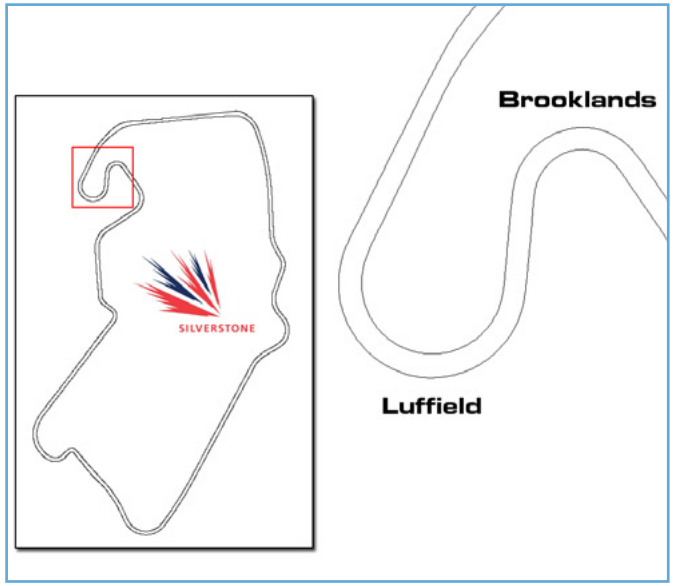
Incidentally, the blue trace was my team mate's fastest lap, who is an instructor at the circuit who was quite surprised when I showed him the data!

Time gained using the shorter path

Above is the data shown in the analysis software, the lower graph is the Delta-T or continuous time difference between the two laps (using position **not** distance as this wouldn't be accurate for such a situation) and the upper trace is the velocity.

You can also see in the video that I am much further over towards the kerbing at this point, and also travelling 6 mph slower.

However, at the turn in point for Turn 15 I have travelled 13.9m (45 feet) less distance than the blue path, which has given me a big advantage."



Back to home turf now, as we go to the fabulous Silverstone Grand Prix Circuit...

The Luffield complex at Silverstone is another great example of a compound corner where there are a number of different lines which can be taken. This time we will examine the line through this complex from Britain's top GT driver, and Goldtrack Trackday owner Calum Lockie.

Many people take a similar line (in red) through this complex, which consists of a wide entry into Brooklands, and a late apex through Luffield.

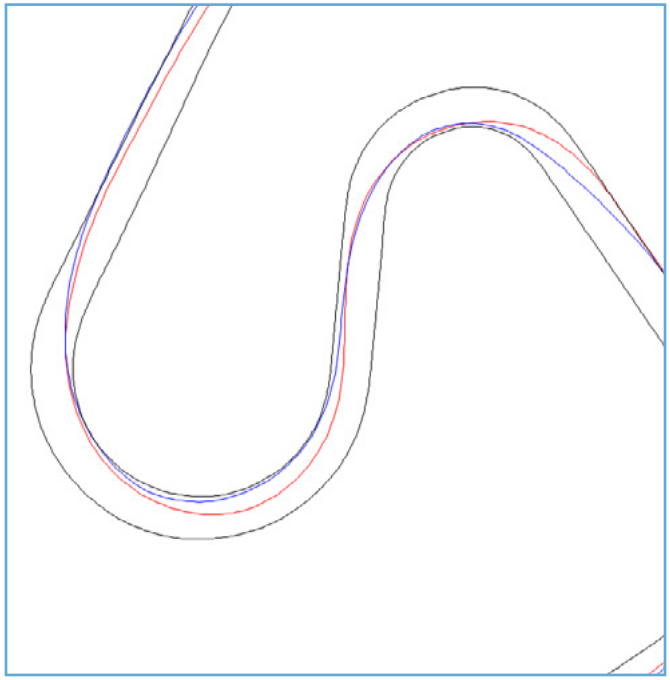
However, if we compare this with the line (in blue) Calum takes, we can see that he uses a completely different approach.

Conventional line through the Luffield complex

Calum's way of tackling these corners is to turn in much earlier to Brooklands, but at a shallower angle, and then he turns sharply on the apex. From here he dives across the track, taking the shortest line into Luffield. He then lets the car drift out slightly, and then turns sharply again on a grippier piece of tarmac.

Taking Calum's commentary from the Video:

Brooklands- "With this line into Brooklands you can brake ever so late, as long as you get the lock on early enough to get it turned in. It's a weird feeling to tighten the lock so much in a corner."



Calum's line in blue through Luffield

Luffield - "There is patch of tarmac which has more grip than the rest, so you can turn the car towards the apex and get really early on the power."

By analyzing the data, we can work out one of the reasons why this approach is quicker than the more obvious line. From the braking point into Brooklands to the exit of Luffield, Calum's line is 11.72m (38 feet) shorter. Therefore the small amount of speed he loses on the apex of Brooklands is more than made up for in the reduction in distance. To put some numbers behind this, the average speed through this complex is around 87km/h, and an extra 11.72m takes an additional 0.5s to traverse.

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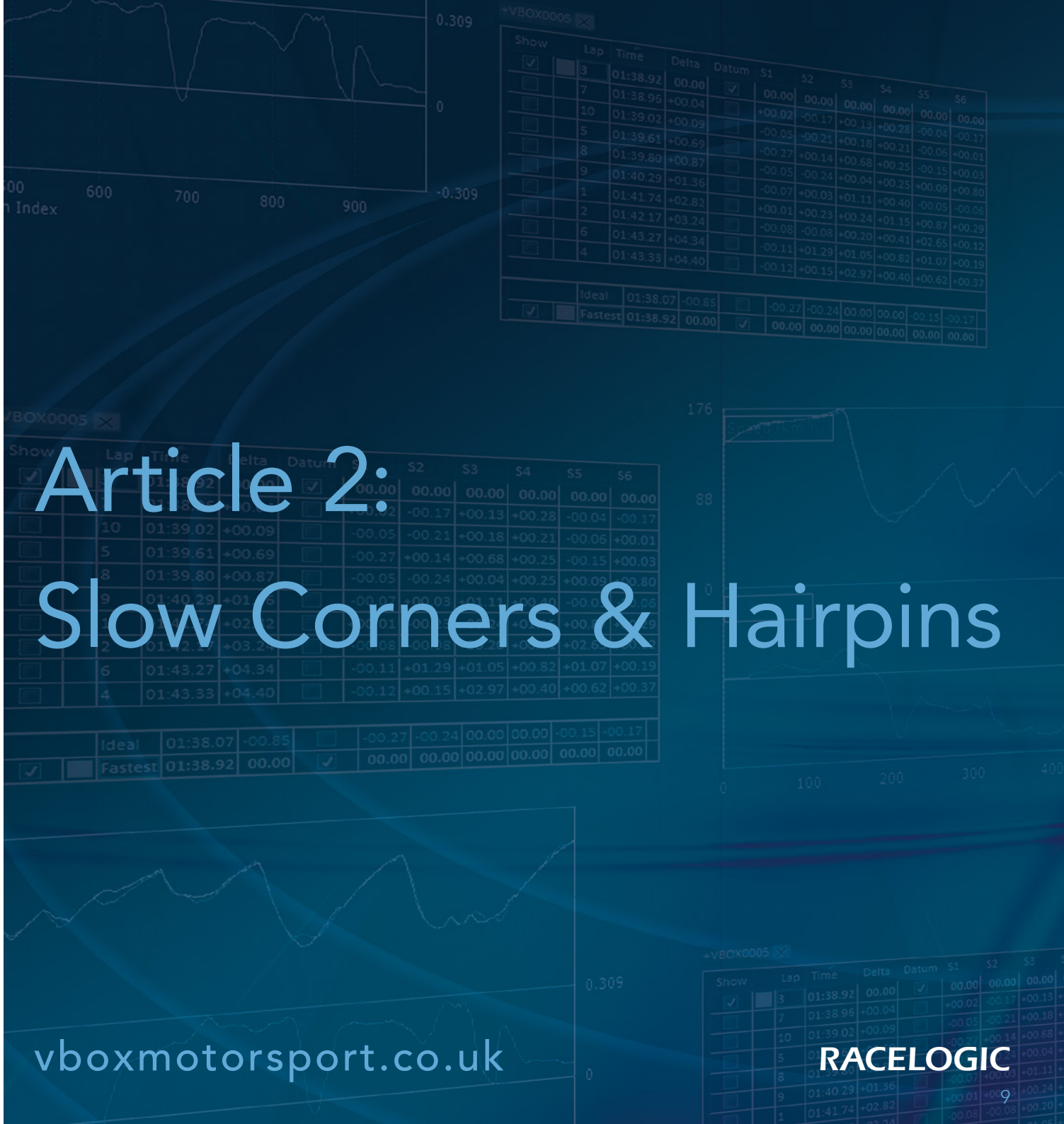
Article 2: Slow Corners & Hairpins



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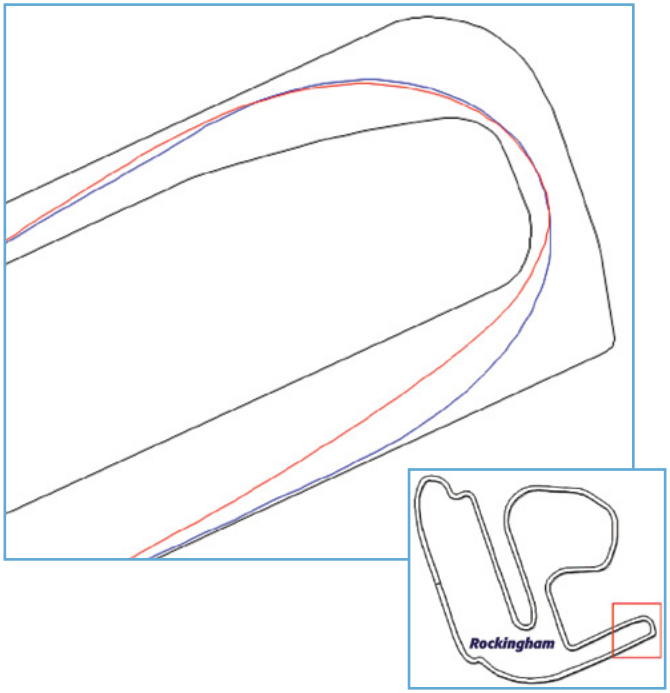
Advanced Circuit Driving Techniques

Article 2: Slow Corners & Hairpins

With the advent of affordable, focused training aids based on Video and GPS, driver training has enjoyed a surge in popularity.

In the second of a series of articles, we will be discussing Slow Corners and Hairpins with accomplished race driver and personal coach Nigel Greensall, to try to help you extract every last ounce of performance from yourself as well as your car.



Nigel Greensall – "You spend more time in slow corners than in fast corners, so you can often gain most lap time by concentrating on these areas.

"Exit speed is important, but equally as important is minimising the time spent in the corner.

You often see drivers taking a big wide entry into hairpins to gain a fast exit speed, but due to the slow speeds involved, this sacrifices huge amounts of lap time, in order to gain a few tenths down the straight.'

The hairpin at Rockingham is a great example. Take the two lines taken in the same car at the same race meeting (above).

The blue line was taken by my team-mate taking a wide entry, and the red line is my preferred approach, which is braking at a diagonal towards the first apex.

The red line is 14m shorter than the blue line, meaning I spend 0.45s less time in the corner.

The blue line does gain 2mph down the straight, but this is only worth 0.15s. Therefore the gain from the shorter line is 0.3s."

"Looking at screenshots from the in-car video (I'm driving the radical in the screenshot on the left) you can see I'm entering the corner much tighter than my team mate.

This means I need to go slower into the corner, but I am gaining time by travelling less distance. This compensates for the slight speed disadvantage onto the straight."

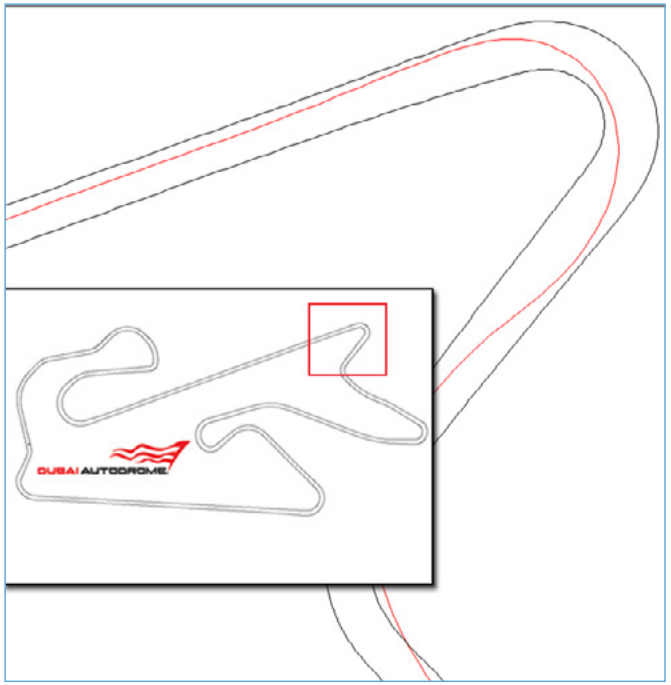
Dubai Autodrome

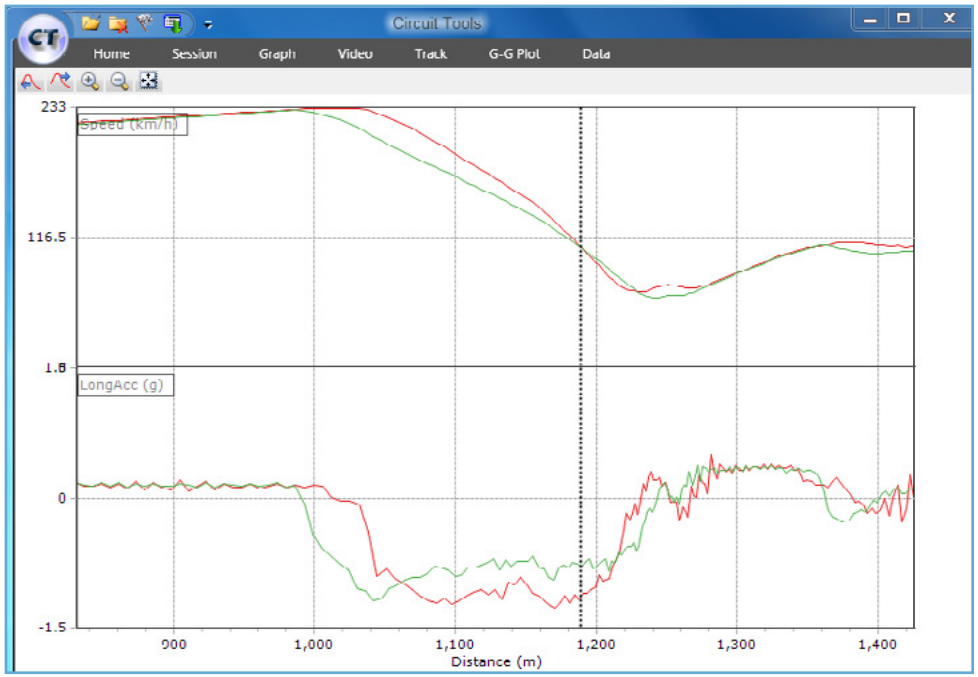
"The next example of a slow corner / hairpin is at the Dubai Autodrome.

I'll take the fastest qualifying lap of both myself and my teammate, and examine the hairpin at the end of the long straight.

As you can see by the graph over the page, our approach speeds are within 1mph.

However I brake 45m later, and harder. This gains me 0.3s, and we both arrive at the corner with very similar speeds.





A screenshot from **CIRCUIT TOOLS**, the new software from **RACELOGIC** that comes free with every **VIDEO VBOX** GPS data logger.

The software can show side-by-side video for comparison, automatically finds the fastest lap, and displays easy to use graphs to show where time was lost or gained.

This means I need to go slower into the corner, but I am gaining time by travelling less distance. This compensates for the slight speed disadvantage onto the straight."

Nigel Greensall – "The graphs above show how it's possible to shave off time on the hairpin at the Dubai Autodrome.

The red line shows my car, whilst the green line is my team mate's car.

The upper graph shows speed through the corner, whilst the lower graph shows acceleration (g-force).

As you can see from the two graphs, we both come in at about the same speed, but I brake later and harder.

You can see the difference in braking from the speed trace, and also from the acceleration trace.

My team mate starts braking about as hard as me, but comes off the brake pedal as he slows down, whereas I maintain the braking force throughout the braking zone.

Onto the hairpin, and exit speed here is key.

This is because you don't brake for another 600m after this point, so I find it best to sacrifice some entry speed into the hairpin in order to turn the car quickly and spend as little time in the corner as possible.

This means I can get on the power early, and carry the extra speed down the next section of track.

Have a look at some side-by-side video screen shots on the next page to show where I position the car to carry the optimum speed around the hairpin."

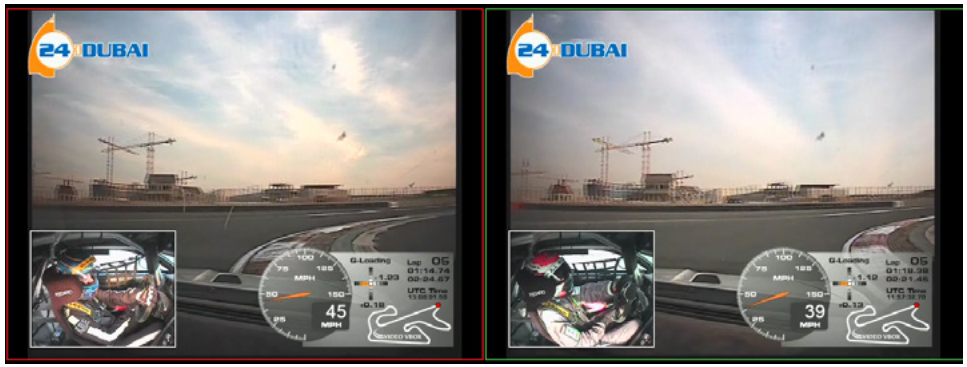
1: The corner entry

(Nigel's car is in the screenshot on the left) At the end of the braking zone, I am using a slightly wider entry angle, by moving left just before turning in. This widens the corner slightly and allows a little more exit speed.

2: Turning in

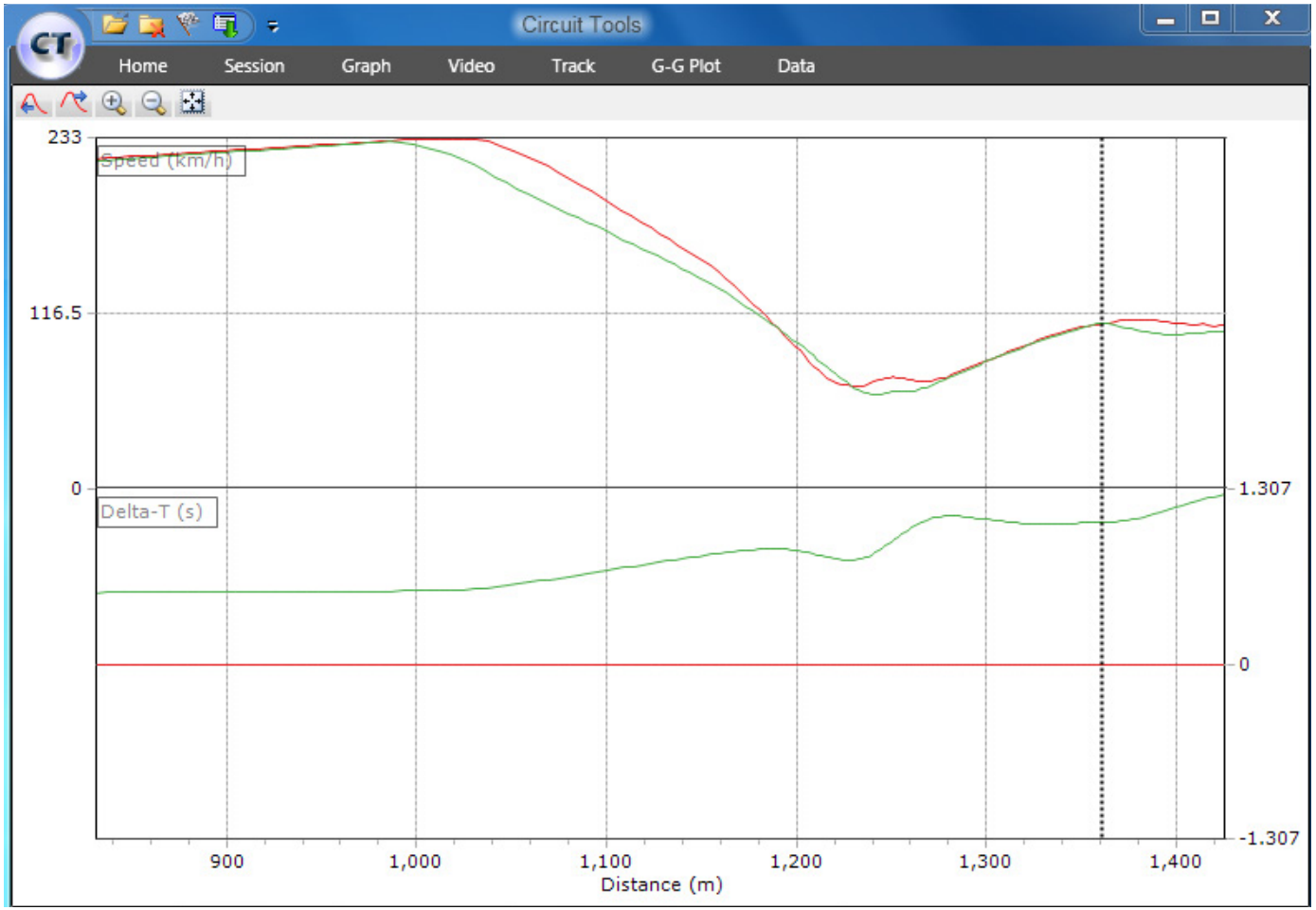
Approaching the apex, you can see that I am now carrying much less speed, allowing me to turn the car more quickly. At this point I have lost a little ground to my teammate, who has carried more speed into the corner. As shown by the graph over the page, the data shows a 0.1s loss at this point.

However, this allows me to get on the throttle much earlier ...



3: Hitting the apex

My car is over the apex, which shortens the corner and allows me to travel less distance. I'm also able to get on the throttle much earlier than my team mate. By taking a bit more kerb I manage 6mph higher speed at the apex (45mph as opposed to 39 mph), as shown by the speed on the graphic overlay of the video.



The **CIRCUIT TOOLS** graphs above illustrate how my car gained 0.25 seconds from corner entry to exit. This is best shown by the 'Delta-T' graph on the bottom, which shows where on the corner my team mate (represented by the green trace) loses time."

See over the page for a link to the side by side video of the Dubai hairpin corner ...

Click the image above for a video of the Dubai Autodrome hairpin featured in this article. http://www.vimeo.com/11327374

Nigel Greensall's car is featured in the video on the left.

We hope you've enjoyed reading this article, and that it has provided an interesting insight in to how one racing driver approaches slow corners and hairpin bends.

There are, of course, many ways to tackle a corner, but looking at the video and data quickly shows which are the most effective!

Advanced Circuit Driving Techniques

Article 3:

“How I learnt how to cut 4 seconds a lap in one day.”

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Advanced Circuit Driving Techniques

Article 3: "How I learned how to cut 4 seconds a lap in one day."

RACELOGIC's MD Julian Thomas on his rise from novice to competitive racer in 24 hours

If you have read the first two articles on compound cornering and hairpins, you might be asking yourself: exactly how effective is **VIDEO VBOX** and **CIRCUIT TOOLS** in driver training in a real life situation? Given a **VIDEO VBOX**, some track time and an expert driver to use as a comparison, just how close to the pace could a novice really get?

To answer this, we have put ourselves through this process…

Julian Thomas with Nigel Greensall and David Power, using in-car **VIDEO VBOX** to analyse their race data

The MD of ***RACELOGIC***, Julian Thomas, has always been a keen trackday driver, but never had a proper attempt at racing. This year he partnered with Nigel Greensall, a very talented and active driver who has raced and won in everything from Legends to Formula One cars.

Julian Thomas – 'I took my ARDS test and the instructor said I would easily pass the test, but to my shock, he said I was driving too slowly to be competitive! This really made me think about my own driving, the car appeared to be on the limit and sliding into and out of the corner, where was I going wrong? I began to realise the difficulty of the task that lay ahead…

On Nigel's recommendation, I booked a day in a FunCup car at Oulton Park, and he came along to provide a comparison. The day was alternating wet and dry, so we got a lot of varied conditions which made it difficult to compare laps directly between sessions. However, it became clear that I just needed to work on my slow, medium and fast corners!

During the day I got to learn the car, and began to think more and more about line and technique as the day progressed.

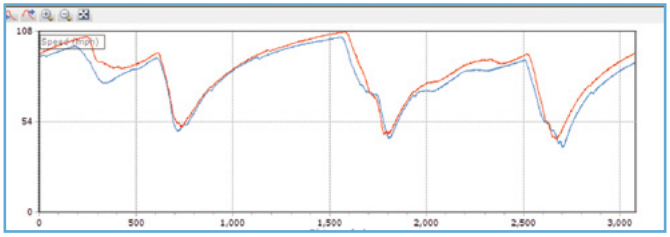
The next outing in the FunCup was a four hour endurance race at Snetterton. I would be up against other novice drivers, but also professional drivers and experienced teams who had spent the winter testing and sorting out their cars.

Our FunCup Car

We rented a petrol FunCup car from JPR who run the series, and Nigel said he put this car on Pole at Brands the Year before, beating the faster diesels, so there would be no excuses on that front! I shared the drive with Nigel and a long time friend of mine, David Power (from Powerflex). Both of us were Novices and hadn't driven Snetterton before.

We had booked two 40 minute slots on the Friday before the race for practice. I went out first to get used to the circuit and managed a 1'30.27", followed by Nigel who sent a benchmark of 1'27.98". Being only 2.29s off the pace seemed great until we looked through the data and saw that Nigel was held up in two corners and lost around 1s! Therefore I was at least 3.3s off at the start, which would put me quite close to the back of the grid come raceday. The ARDS instructor was right!

I then spent some time studying the data, and



The 'before' comparison, Nigel's data in red, using **CIRCUIT TOOLS**, free with **VIDEO VBOX**

talking to Nigel, and we worked out the two main corners I was losing time, which were the two slowest corners. Nigel was taking a different line to me, and getting on the power much earlier which meant he was carrying this extra speed down the next section of track.

I then went out for the next section and eventually worked down to a 1'28.33", shaving a massive 1.94" off my time, just with one analysis session! This was now putting me into the competitive midfield area, a great improvement, but room for more.

In addition to the 2 sessions on Friday, we also had a 1 hour 'qualifying' session on Saturday, but since the grid was to be drawn out of a hat, we used this as a last minute training session. I had spent some time the night before going through the data, comparing my fastest laps with Nigel's, and I was pretty confident I knew of a number of areas where I could find some more speed.

Typical close racing in the FunCup series!

I went out first in qualifying and worked down to a 1'27.46", so I had found 0.87s overnight, and it would be enough to put me 4th in class out of 19! Nigel then went out and set what would be the fastest time in our class of 1'25.92", so I was now only 1.53s off his pace.

I was really relishing the race, as this would give me plenty of time in the car to find some extra speed.

It was honestly a pleasure using **CIRCUIT TOOLS** in anger, every time I compared my latest lap with Nigel's, I could quickly see areas to work on.

I made good use of the delta-T channel to see where the lap time was ebbing away around the lap, and the video to watch his lines, apex points and driving style.

We also discussed and then watched his slipstreaming technique, as he stayed a lot closer to the car as he overtook to maximise the slipstream when alongside another car.

One point which leapt out to me was how far ahead he was looking in comparison to me, see the screenshot below for an example of the Esses where you can clearly see Nigel looking a lot further around the corner than me. This was another area in which I could concentrate.

Side by side **VIDEO VBOX** screenshot in **CIRCUIT TOOLS**: You can clearly see that Nigel is looking a lot further round the next corner than me

We were drawn 29th out of 32nd on the grid, which would certainly make the race exciting! We decided on Nigel going first and using his experience to claw back some of the lost places. After Nigel's 40 minute stint he had worked his way back up to first in class, it was a real privilege to watch such a display of race craft and natural speed at work. He had also managed to shave a little bit off his fastest time to set the fastest lap of the race (in our class) of 1'25.75".

It was my turn next, and I was dropped right in at the deep end; we were leading our class, and fighting in amongst a big bunch of competitive teams! It took me a little while to acclimatise to being in the middle of a pack of competing cars, whilst maintaining quick lap times.

The FunCup series is run really well, and as part of their forward thinking approach to racing, we all had a one way earpiece to the Race Director who gave out information about incidents, Safety Cars and penalties as we were driving. The first time his voice crackled into my ear, I promptly drove off the track as I tried to compute what he was saying, whilst driving on the limit! However, I soon worked out a system, where I wouldn't overly concentrate on what he saying, but play it back in my head when I reached a straight piece of track.

After my first stint I had managed to equal my qualifying time, but I knew there was more in the car if I could just squeeze it out.

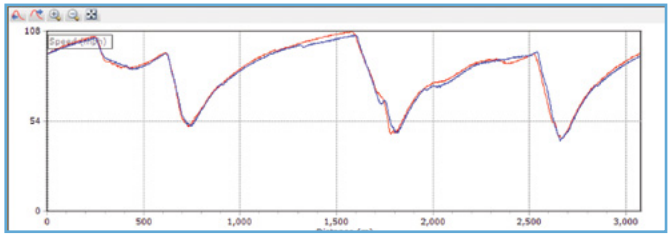
Learning the art of slipstreaming - footage using **VIDEO VBOX LITE**

I then spent the downtime before my next 40 minute stint comparing my race laps with Nigel's new fastest lap, and quickly worked out where the crucial time was being lost.

It was small differences all round the lap which added up to 1.71s, a combination of using more kerb at one corner, braking a bit earlier at the next, settling the car on the throttle on the entry and being more aggressive with the steering on the slower corners.

We had lead the class now for 2 hours when my second stint came round, but unfortunately a problem with the carburettor gasket dropped us to last place due to a 20 minute pitstop.

Nigel then told me to treat the last stint as a qualifying session, and he was putting the times of the class leaders on the pitboard with mine underneath with strict instructions to match or better their times which were in the 1'26" bracket. I also had the **VBOX OLED DISPLAY** showing me real time lap times in the car, so I was all set for the challenge.



The 'after' comparison, using **CIRCUIT TOOLS** Analysis Software.

Comparing laps in **CIRCUIT TOOLS**

My fastest lap

Nigel's fastest lap

Armed with the new analysis data rattling round in my head, I headed out of the pits and put my head down.

Within 4 laps I had beaten my best time, and within 10 laps I had worked down to a 1'26.26", which turned out to be faster than set by any other team during the race by 0.3s!

Incidentally, my team mate, David Power had shaved 2.74s off his initial times, and was also putting in competitive laps which had kept us in the lead of our class, and he had never driven Snetterton or a FunCup before!

In conclusion, if we hadn't had the gasket failure (always the 'if onlys' in racing!) we would have won our class by some margin, which is quite an achievement for 2 novices.

The combination of Nigel's coaching and the **VIDEO VBOX** had brought us up to a competitive speed really quickly, and made the whole experience very special. It almost felt like we were cheating, and by-passing many hours of testing and practice, but in reality we were approaching the race using all of the modern tools at our disposal!

Will we be racing again? Oh yes, our next outing will be the Spa 25 hours in the same car, so even more time to analyse the data and try to set some competitive times!'

Advanced Circuit Driving Techniques

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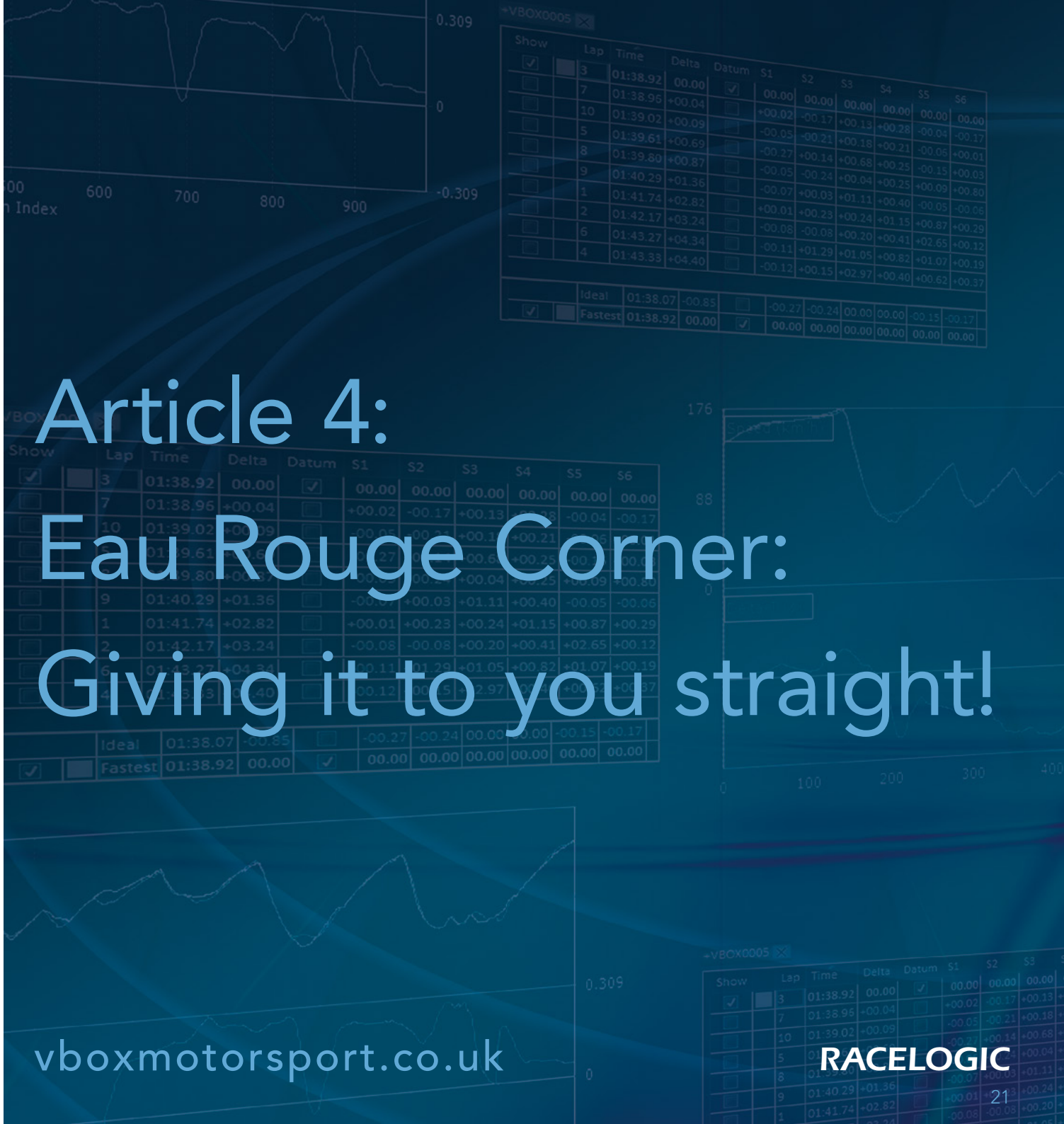
Article 4:
Eau Rouge Corner:
Giving it to you straight!



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RACELOGIC

Advanced Circuit Driving Techniques

Article 4: Eau Rouge corner: giving it to you straight!

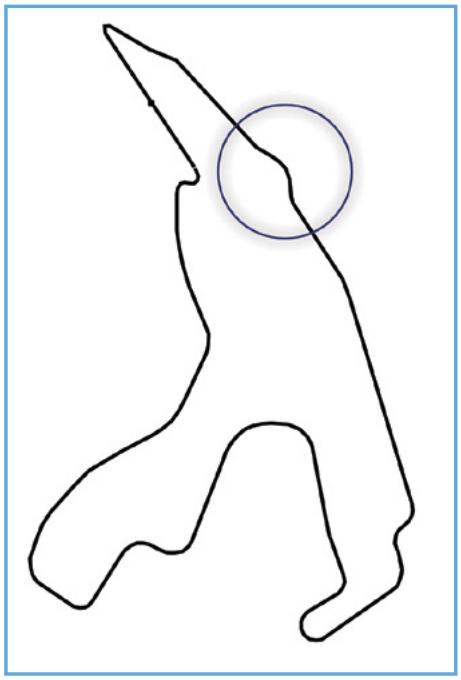
Video analysis shows how to gain a second through one of the best corners in the world

As one of the world's most complex fast corners, Eau Rouge is revered by racers.

Drivers know that you must take Eau Rouge flat to take advantage of the available down-force and gain speed onto the Kemmel straight.

What many don't realise is that the straight is a kilometre long, with a 70m uphill climb.

If you don't get Eau Rouge right you've lost vital time.



In this fourth article, we ask racing driver and instructor Nigel Greensall to give us his tips on how he tackles the famous corner to gain the most speed up the straight.

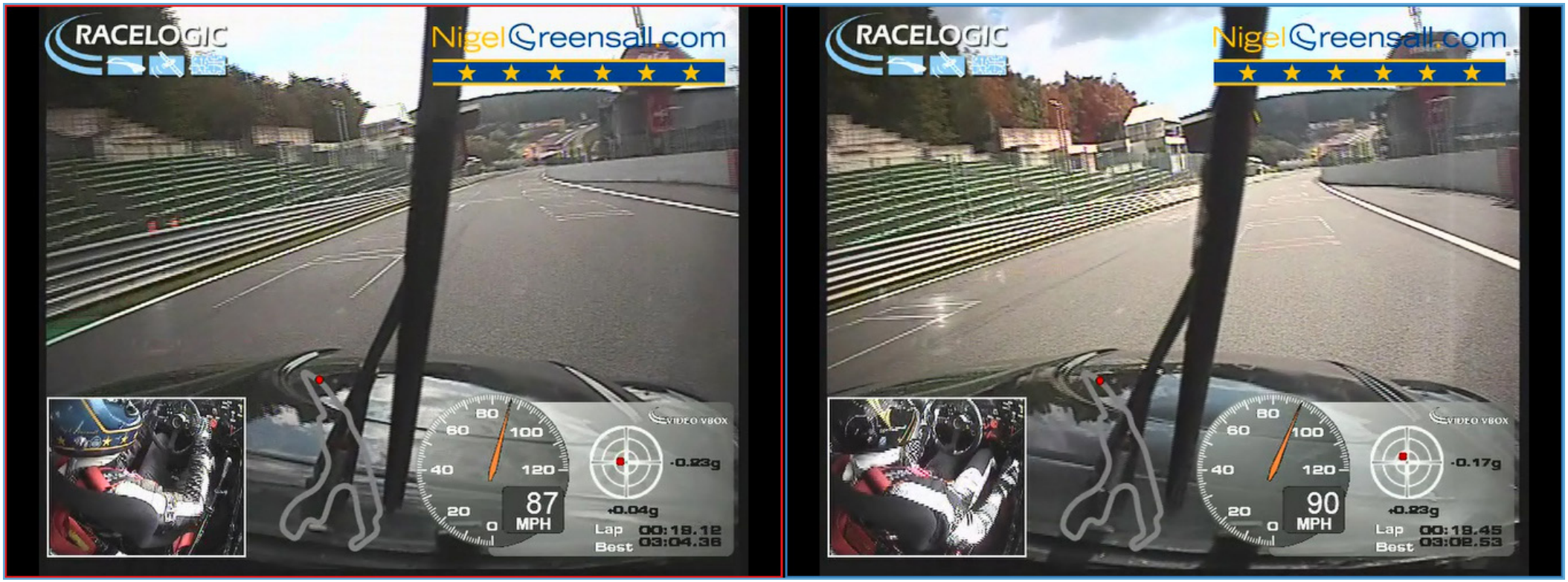
Nigel took some data from a practice run in a FunCup race car, featuring one of his laps and a comparison lap from his team mate Dirk (a very proficient racing driver) in the same car. FunCup cars are single seater race cars based on VW Beetles.

They're ideal to analyse different driving techniques because with their 160bhp engine and inefficient aerodynamics, it's even more important to perfect driving technique because there is little power to rely on.

At the same time, if you are racing a Radical or even an F1 car the principles discussed are just as applicable.

We start our discussion from the exit of La Source, and follow the circuit through Eau Rouge and to the end of the Kemmel straight, where Nigel has gained a whole second over his team mate, despite Dirk actually having a faster time in the entrance to the section.

So how did Nigel gain a second on this corner using the same car?...



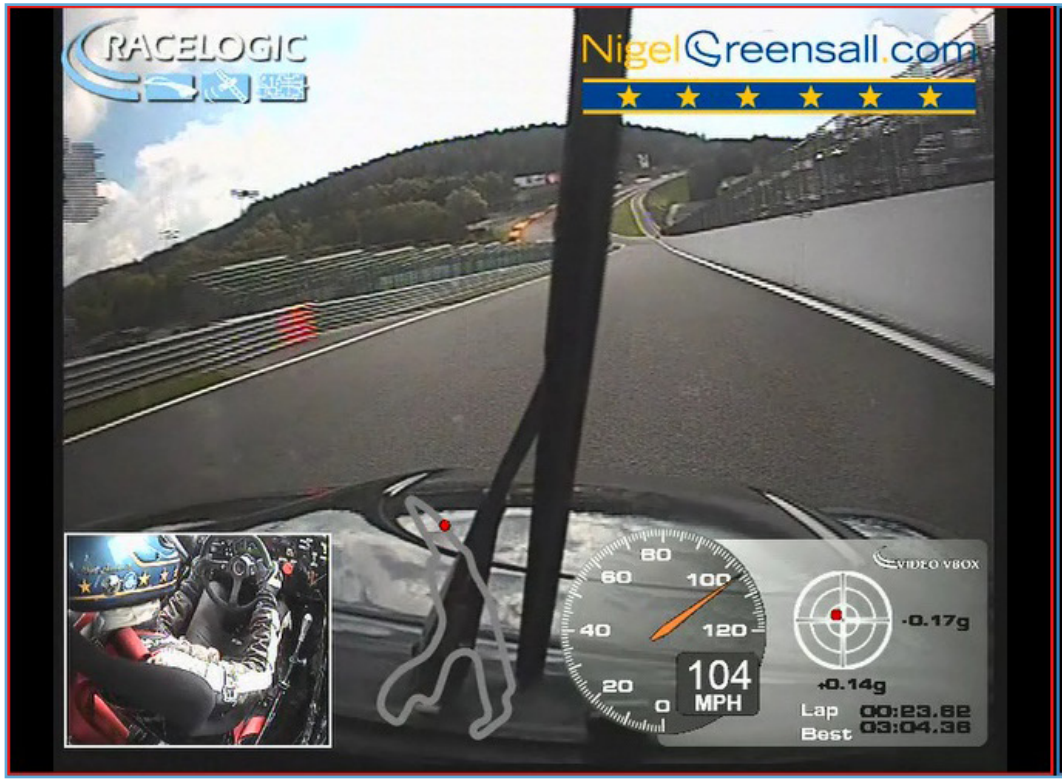
The straight from La Source

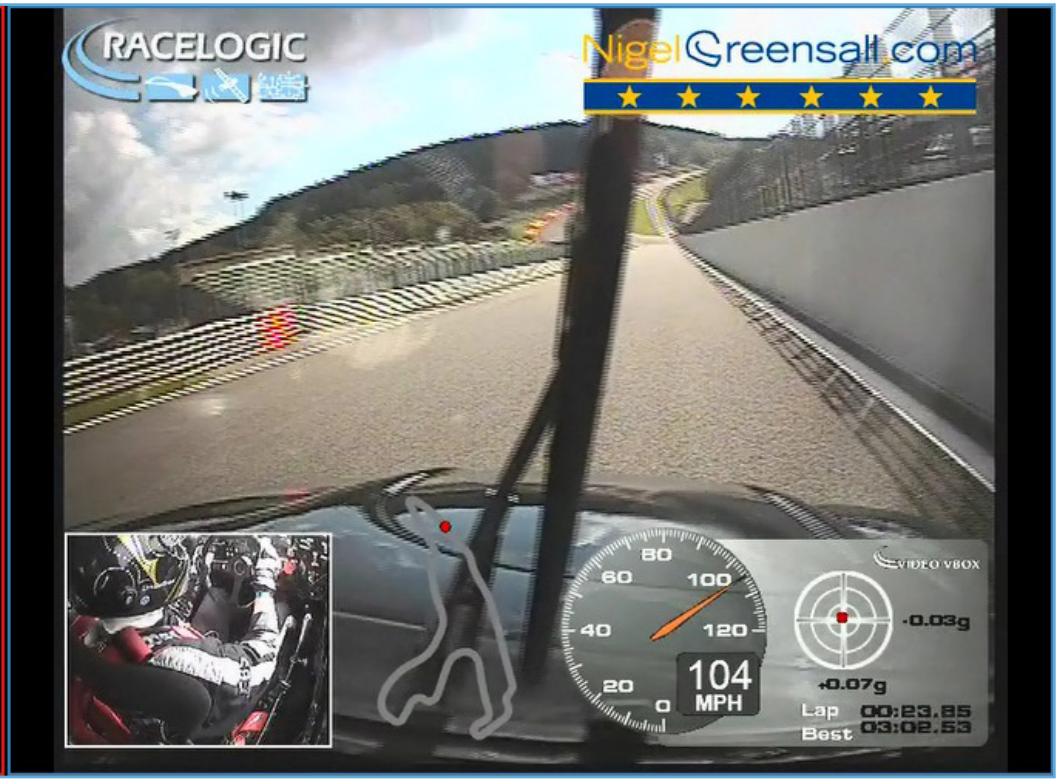
Nigel Greensall: "In the comparison screenshot, you can see that Dirk (in the right hand screenshot with the blue outline) is actually going 3mph faster than me, coming out of La Source with good speed. He's just 0.2s behind me up to this point.

However in an attempt to set himself up for the upcoming Eau Rouge, he goes too close to the wall on the right, whereas I stay in the middle of the track.

I positioned my car in the middle of the track for 3 reasons:

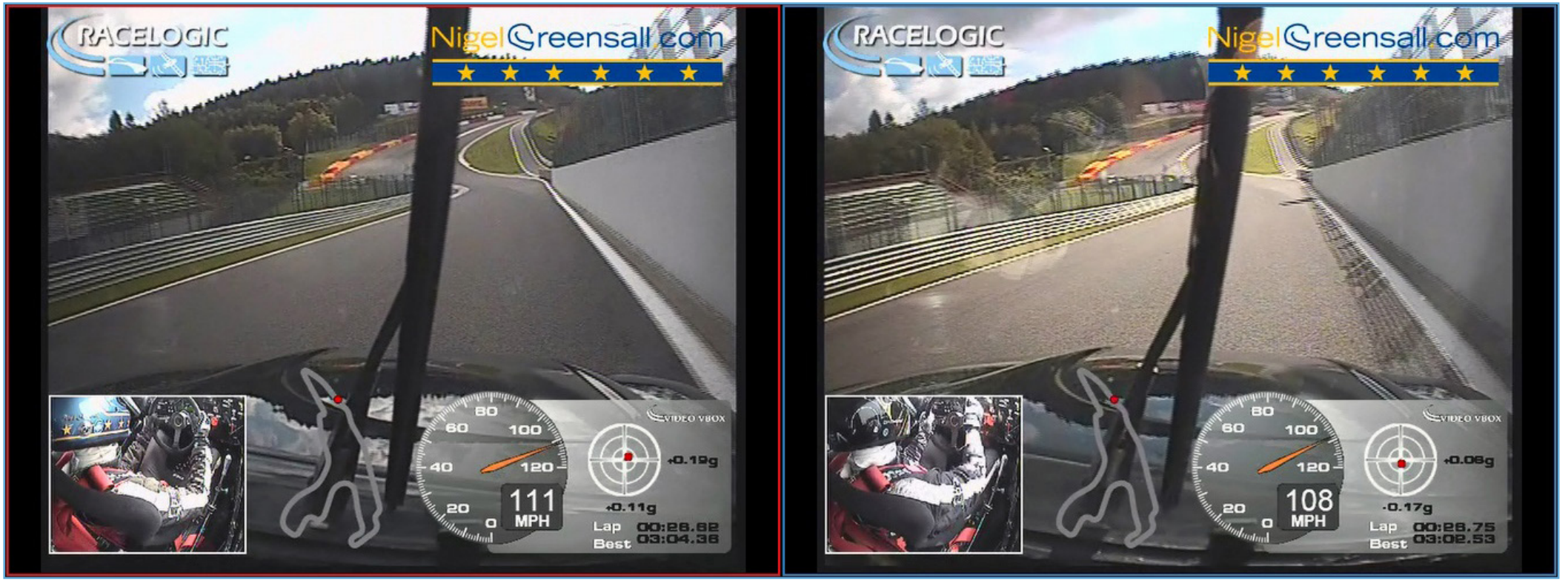
- To lessen the drag effect of the concrete wall – the closer to the wall you drive the more drag you encounter with the air bouncing back at the car and slowing you down
- To take advantage of the increased grip between the grid-lines
- To gain better visibility (you can see far more of the approaching section from my view at the centre of the track), to help anticipate any incidents



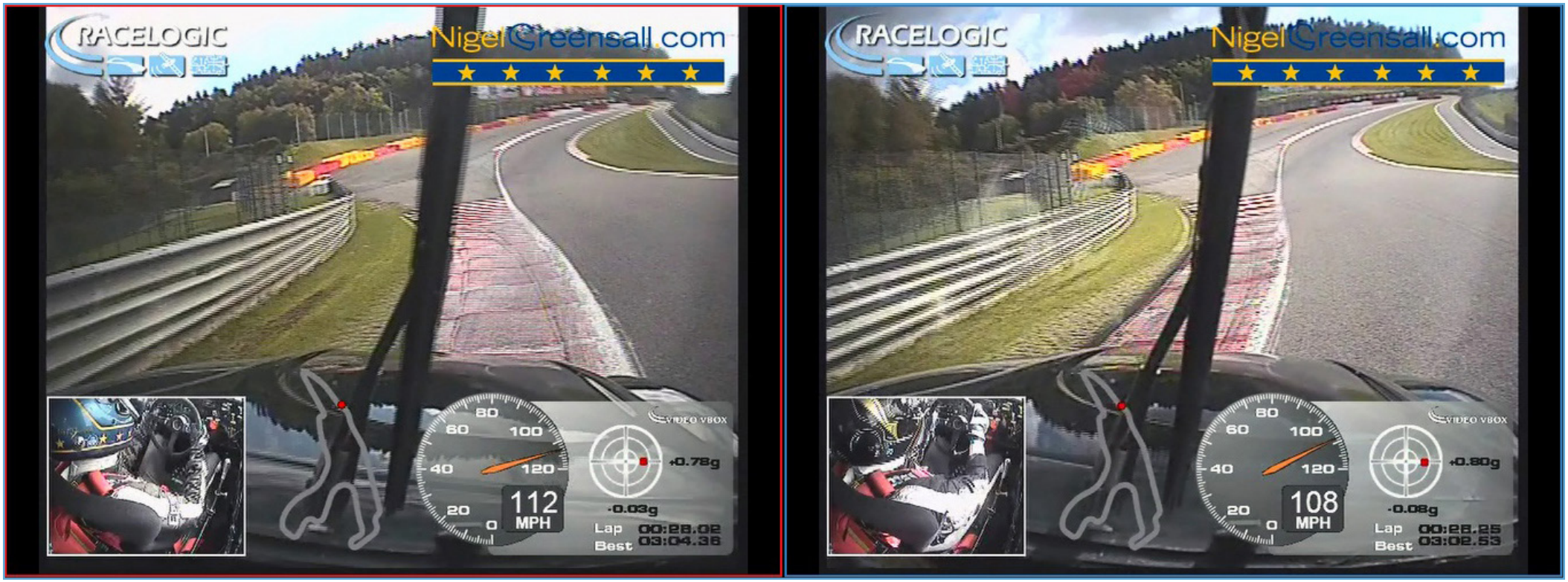


The approach to Eau Rouge

As you can see from the screenshot, in the approach to Eau Rouge my speed has now caught up with Dirk's and I am accelerating quicker, with 0.14g as opposed to 0.07g. This is because I have encountered less drag from the wall, but this is where I start to edge towards it to gain space.



Having gone very close to the wall, my entry onto Eau Rouge is now as wide as possible. This means I need to turn less sharply than Dirk which will help to maintain more speed. From my car you can see that the two apexes are lining up, showing a straight route from the first apex to the second.

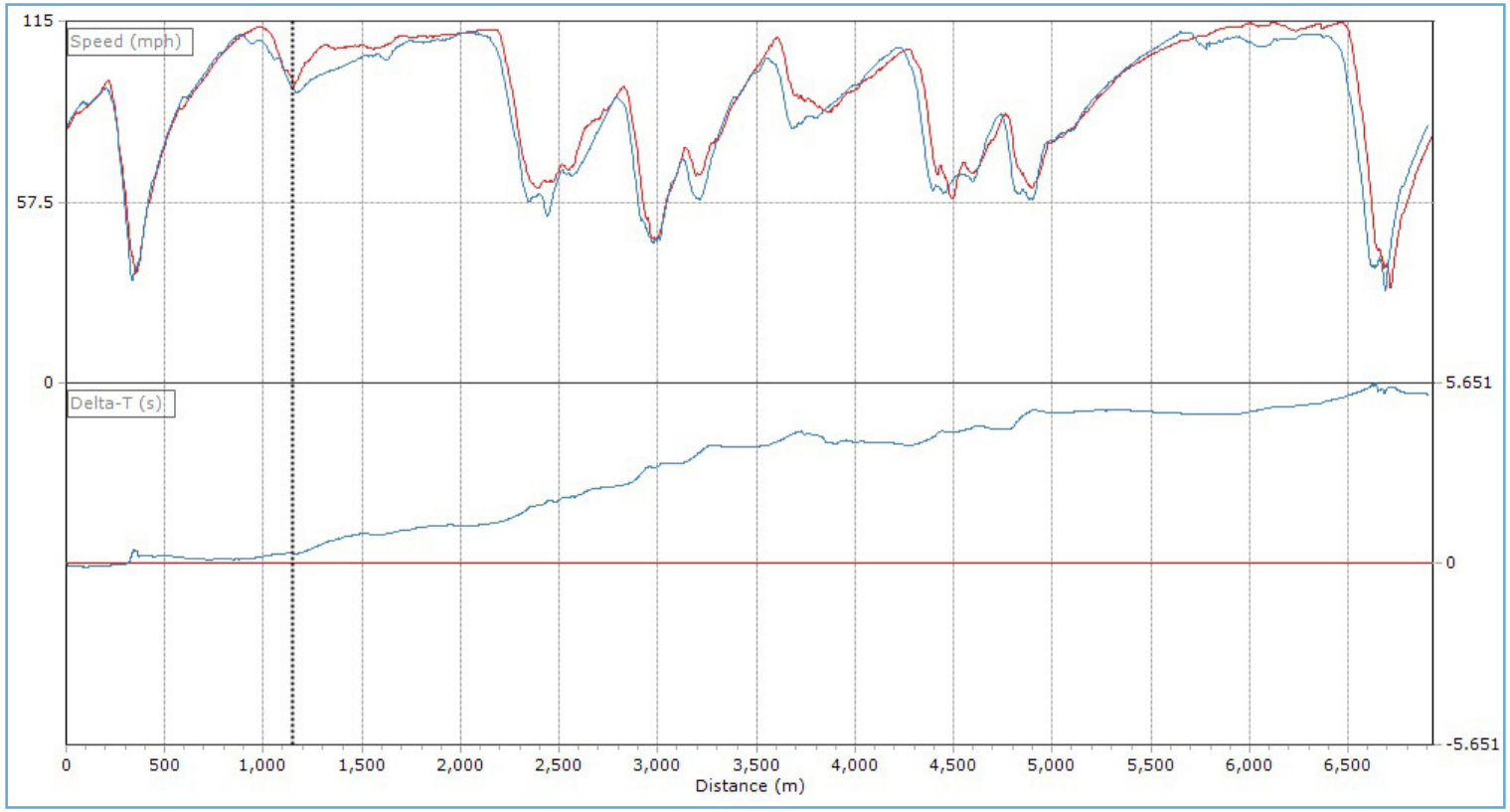


The first apex of Eau Rouge

The differences in track position are very clear here. I am cutting the corner as much as possible with just two of my wheels still on the track and the other two on the concrete strip beyond the curbing.

The line I have taken is less sharp than Dirk's (right), which means I only need to straighten up to hit the next apex, whilst Dirk has to lift a tiny amount in order to turn into the second apex.

I have now gained 4mph because I can straighten up sooner whilst Dirk is still scrubbing speed.

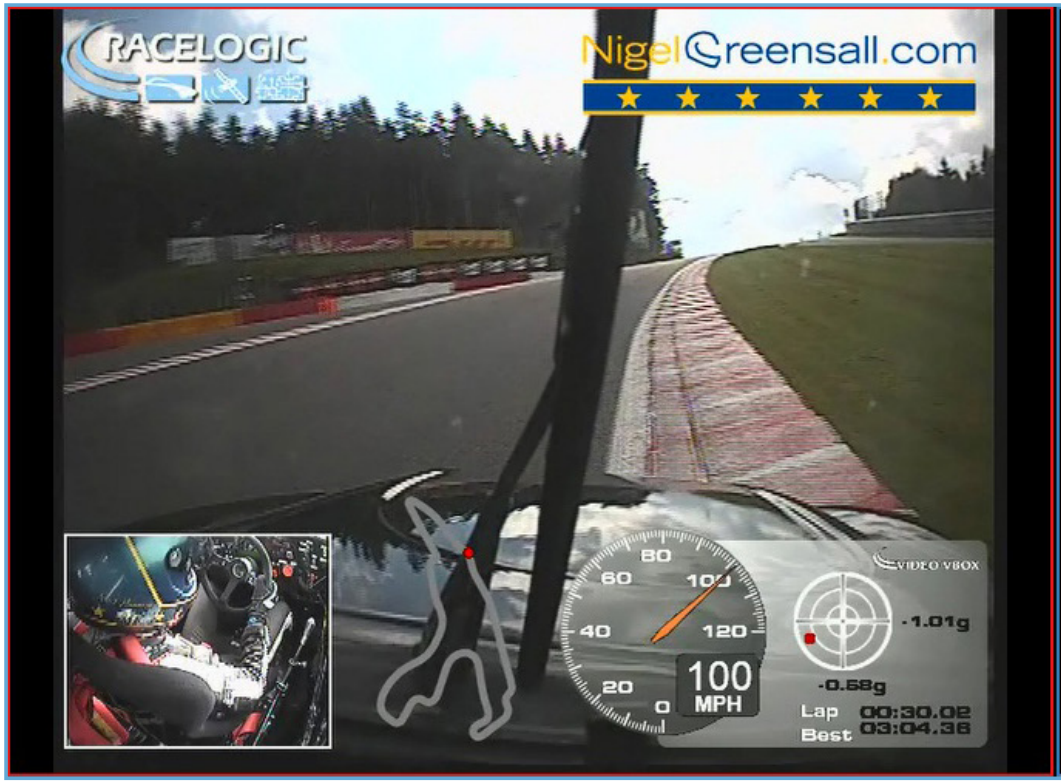


This shows an entire lap of Spa, where my lap is represented by the red line, and Dirk's by the blue. The top graph is a speed trace, which allows you to optimise your braking points and see where more speed can be carried.

The bottom graph shows the 'delta' time for the lap. This shows where Dirk lost time in his lap in comparison to mine. The position of the dotted cursor line is half way through Eau Rouge.

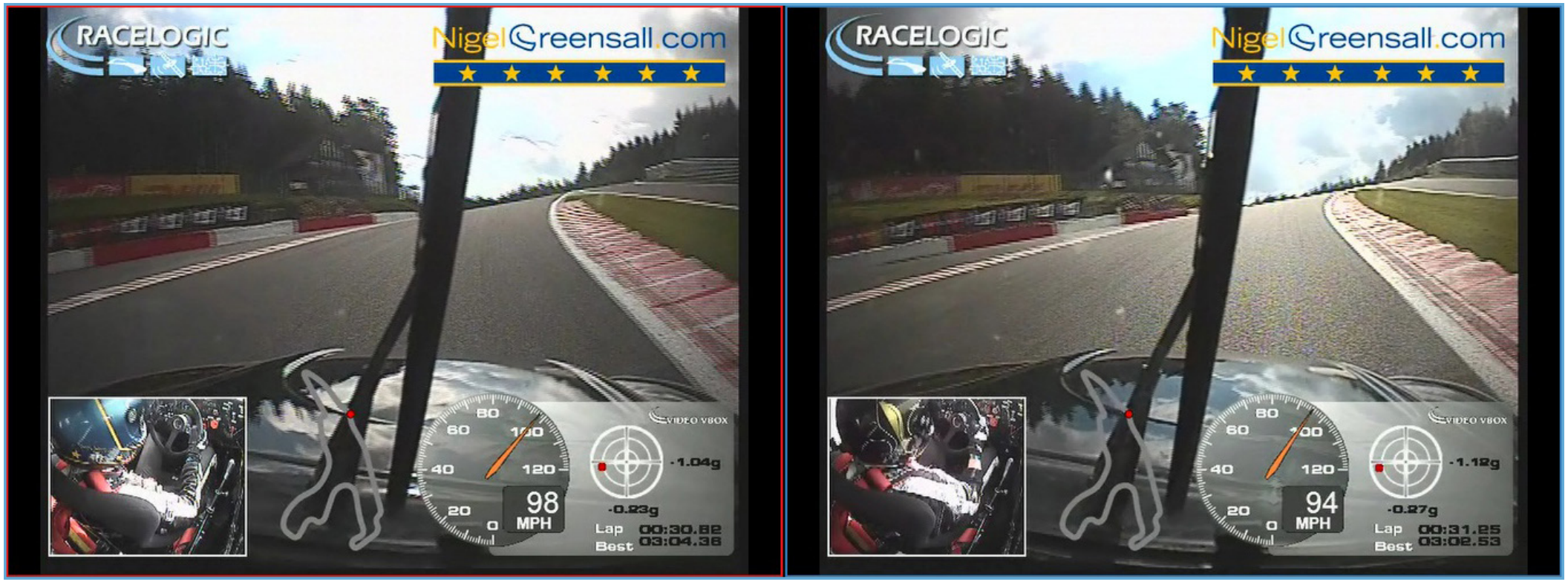
Before this Dirk and I are almost neck and neck, but it is clear that he loses considerable time in comparison to me on Eau Rouge. This impacts the rest of his lap, meaning that he is 5.6s slower than me in the practice session. However once we had looked at this simple data and seen how Dirk could improve his fast corner technique, he was able to take 2.5s off his lap time in the race that followed!

It's possible to see this delta time live in the car with **RACELOGIC's new predictive lap timer, which connects to a VIDEO VBOX**. The predictive lap timer takes your (or another driver's) best lap and shows you a real time, easy to glance at graphic on an **OLED DISPLAY** of where you are losing or gaining time in comparison.



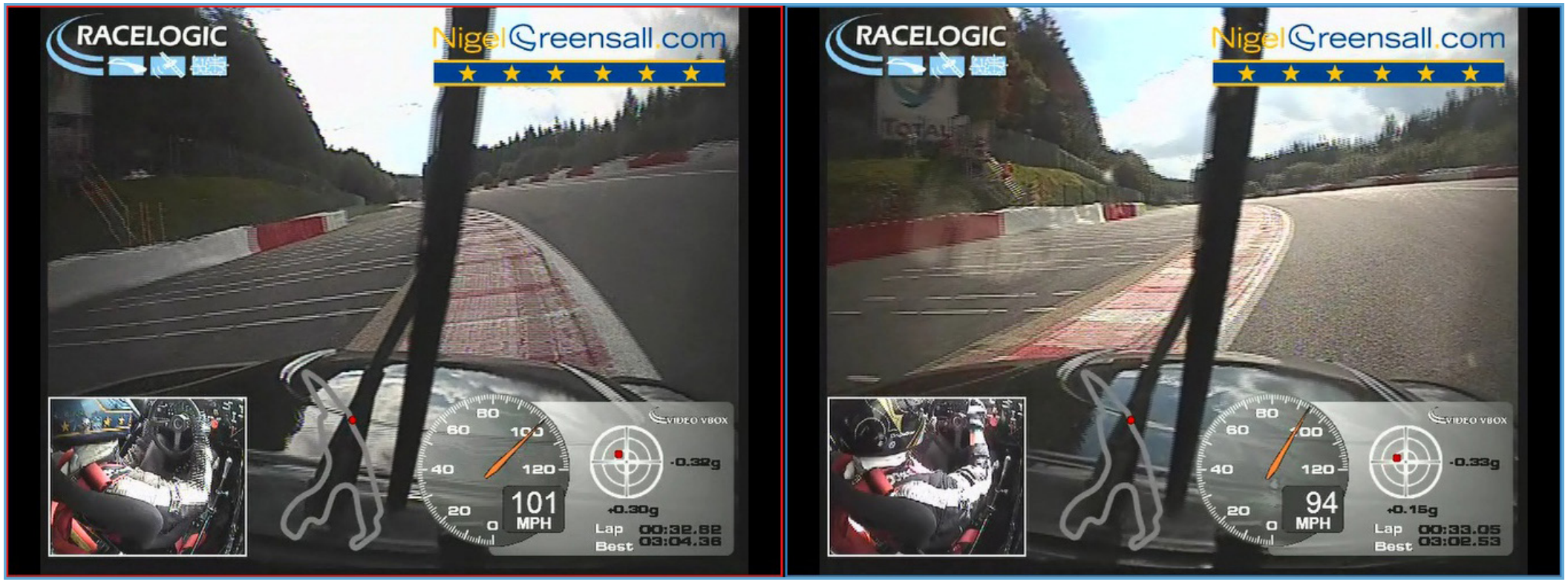
Radillon

In the apex of the second corner of Eau Rouge (Radillon) you can see in the screenshots that I am again using more of the track, driving over the curbing in order to straighten the fast corner. Whilst the speed of the two cars is now the same, at 100mph, I am in a better position to carry this into the next apex.



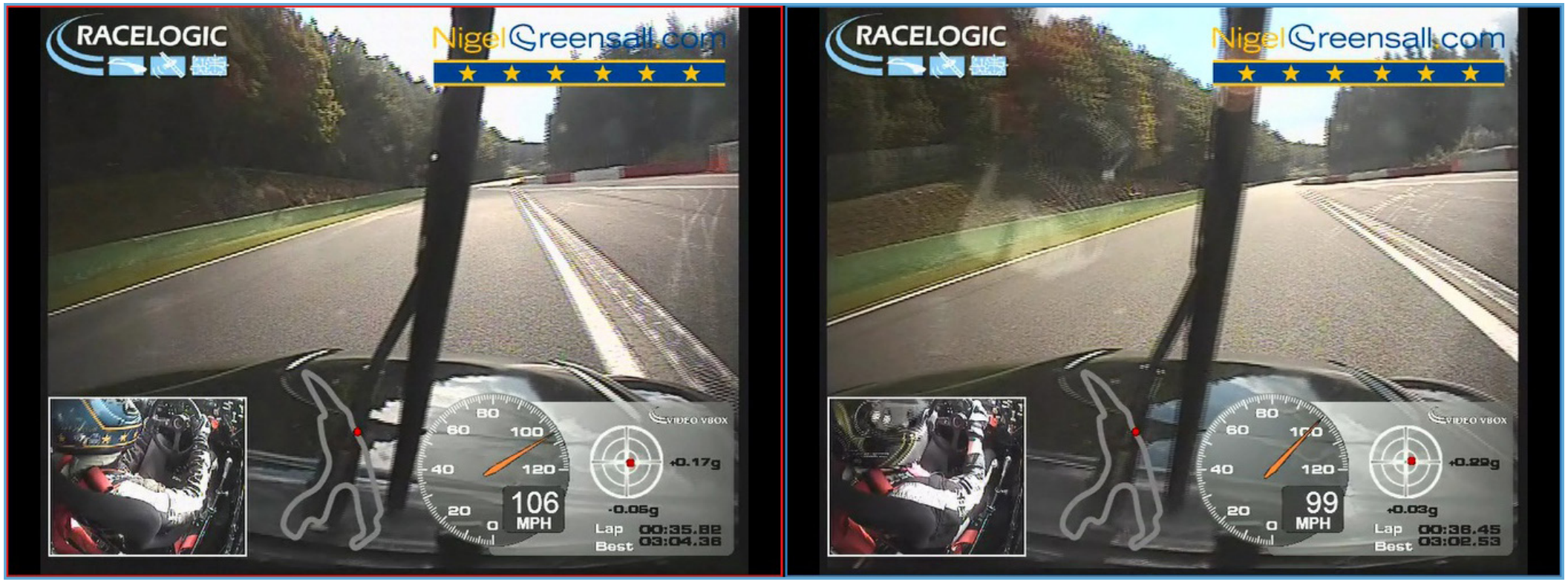
Exiting Radillon

0.8 of a second later and Dirk (right hand screenshot) has lost 6mph because he is turning tightly, due to his driving line in preparation for the corner. My line in the approach has set me up to release the steering earlier, losing only 2mph.

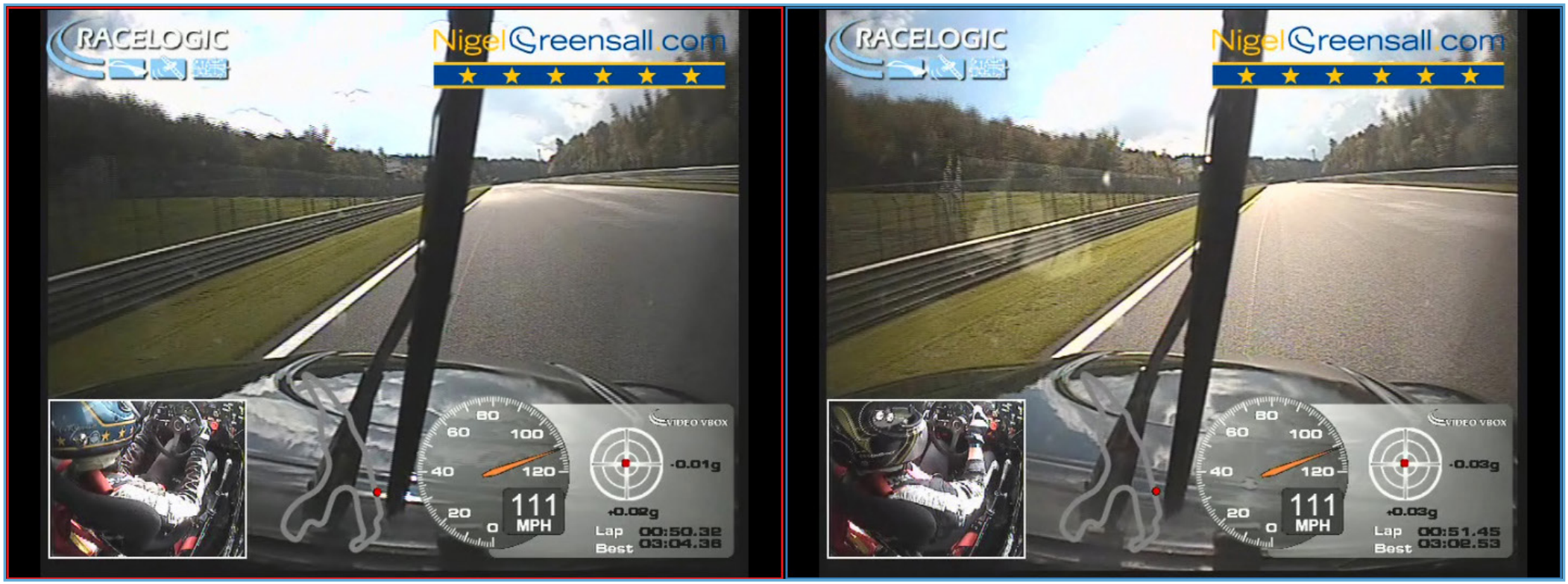


The final apex at Eau Rouge

The differences in steering angle and driving line are clear here, which is why my speed increases to 101mph whilst Dirk stays at 94mph. Again, I am using the whole track by driving over the curbing and making the corner straighter. With less steering lock applied than Dirk, as shown in the picture in picture screens, my car is released to travel in a straighter line and I am able to build speed, with 0.15g more acceleration than Dirk.



At the exit of the Eau Rouge complex and onto the start of the Kemmel Straight I am going 7mph faster than Dirk. The difference in speed is due to my driving line, keeping away from sources of aerodynamic drag, making the corners straighter, and keeping steering input to a minimum.



The end of the Kemmel Straight

By the end of the kilometre long Kemmel Straight both our speeds are the same (111mph – the top speed of our FunCup car). However if you look at the lap time in the bottom right hand corner of each screenshot, you can see that I have gained an entire second (00:50.32 compared to 00:51.45) over Dirk.

Watch a video of the corner by going to:
http://www.youtube.com/watch?v=9IeBx6EAQGA

So how did I gain a second on Eau Rouge?

- I kept away from the aerodynamic drag of the wall after La Source in the approach to Eau Rouge
- I used every inch of available space, with just two wheels on the track through each apex
- I kept steering input to a minimum in order to release the car to gain speed

Despite being a very competent racer, due to his driving line Dirk had to lift very slightly in the entrance to Eau Rouge. This lift was barely perceptible, and equated to 0.1s increase in lap time. The rest of the 1 second deficit in time was due to the differences in our steering technique, straightening out every corner. This was worth 0.9 of the second"

We hope you've enjoyed reading this article, and that it has provided an interesting insight in to how one racing driver approaches fast corners and the legendary Eau Rouge in particular. There are, of course, many ways to tackle a fast corner, and looking at the video and data quickly shows which are the most effective!

Advanced Circuit Driving Techniques

VBOX MOTORSPORT

Article 5: Why traditional cornering techniques aren't always the fastest.

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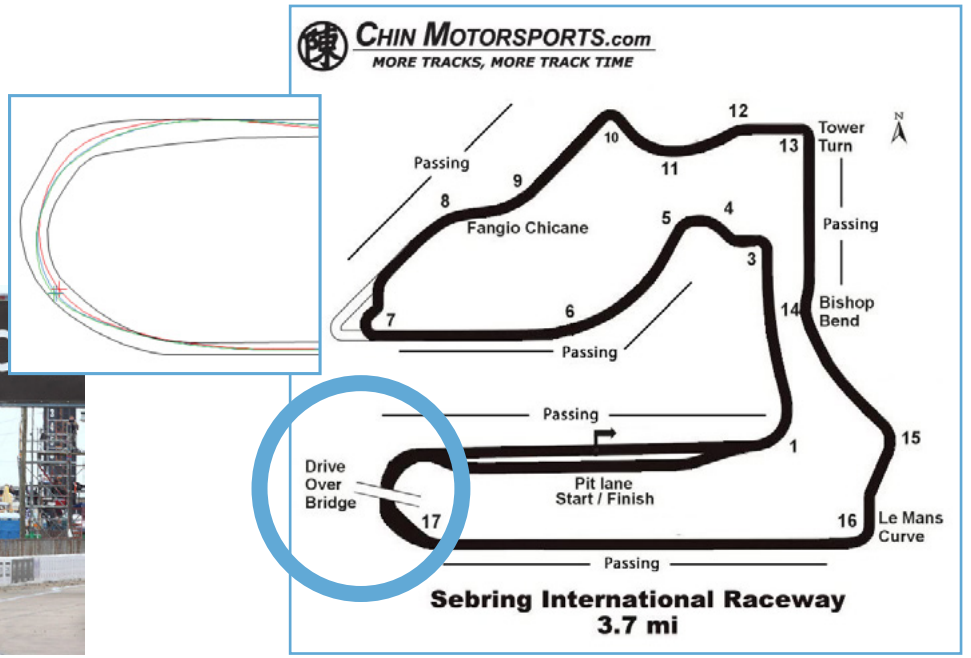
Advanced Circuit Driving Techniques

Article 5: Why traditional cornering techniques aren't always the fastest

One racing driver reveals his secrets on how he tackles long corners, showing how he gained half a second on 'Sunset Bend' at Sebring over other drivers who were using the traditional racing line.



Sebring, Florida. If you're involved in USA motorsport, you've either been there or you want to go. Built on an old WWII air base, the classic circuit is often recognised for its famous, high-speed turn 17, otherwise known as 'Sunset Bend'.

It's a long, bumpy, fast right hander that can make or break your speed down the finishing straight. Because it can fit up to three cars wide, drivers are often divided on the best way to take the corner to maximise the available space and handle the challenging surface.

As the fifth in our series of articles discussing advanced circuit driving techniques, racing driver and instructor Nigel Greensall gives us a controversial perspective on how to best tackle the 500m long turn 17. He reveals his secrets on gear selection, driving line, surface awareness, and corner exit, and why they're essential in getting a fast lap. He also explains why cornering is not just about the entry and exit – and why what you do in the middle of a long corner can make a huge difference to your time.

The following video and data was taken at a Chin Motorsport test session, where Nigel compared his technique with two fast Sebring locals in a Mazda Miata track car.

Taking the fastest lap of each driver, each took a different approach at 17, with Nigel having the lowest entry speed by some margin. However, Nigel's time for the whole corner was still half a second faster. Read on to find out why.

Corner Entry: Video screenshots taken from the best lap of each driver. Nigel Greensall above left, outlined in red. He's braking earlier to balance the car and maintain speed around the long bend.

Nigel Greensall:

1. Entry

"The success of the corner depends on your preparation. The three screenshots (Corner Entry, above) are taken at the point the two other drivers start braking for turn 17. As you can see, my speed is much lower than the other two drivers. In fact I started to brake 50m earlier.

It is very tempting to brake late here, and you will often hear talk in the Sebring paddock of just how late some drivers like to brake for Sunset Bend.

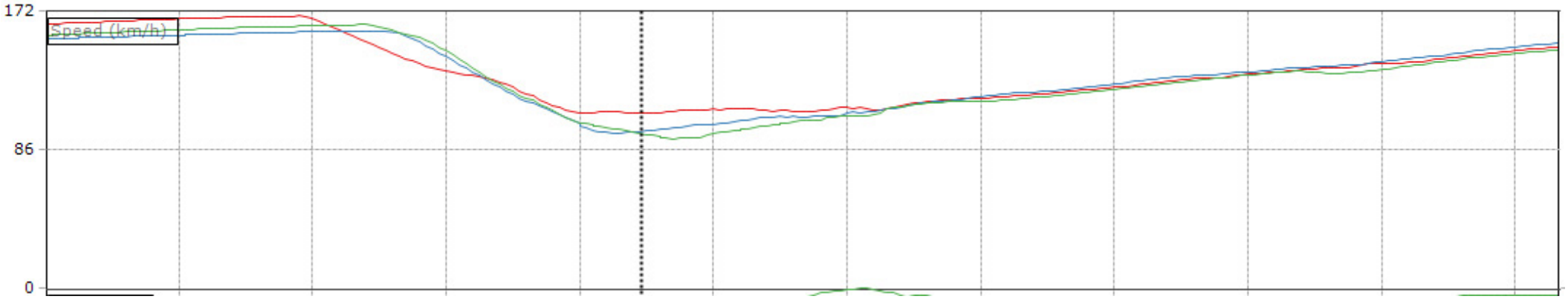
However, I have found that this can compromise mid corner balance and speed, as I will demonstrate.

Mid Corner: Nigel's speed (left) is 5mph greater than the next fastest driver. He's holding a tight line and is back on the power now.

2. Mid-corner

"In the screenshot above (Mid Corner), I have finished braking, and am back on the power (see the positive G on the graphic overlay of the screenshot outlined in red), which shifts the weight backwards and balances the rear end. This allows me to hold a tight line through the mid section of the long bend. The two other drivers are still braking, which carries them deeper into the corner."

"At this point my minimum speed is at least 5mph more than the other drivers (shown by the speed trace graph, below), and also I am on a shorter, tighter line. This is where I gain the majority of the time in turn 17."



Speed trace for Turn 17: Nigel's lap is in red. He clearly brakes earlier than the other drivers, and his minimum speed is much higher through the bend, which helps him gain half a second.

"Gear selection is also crucial at this stage. Having previously tried taking the corner in 4th gear, I soon found that this caused the car to run too wide over the bumps and compromise exit speed. By using 3rd gear I was able to stay tighter to the apex which helped avoid the bumpy surface."

Exit: Nigel (left), takes advantage of the whole width of the track to build speed

3. Exit

"On the exit of the turn, just before the bridge, there are several bumps which are caused by the large concrete slabs that made up the old air base runway. This change of surface occurs just where you are accelerating onto the straight, so it is critical that the car is balanced here! In a more powerful car, you may want to turn more before this point, allowing you to straight line the bumps, gaining more traction out of the corner.

The exit onto the start/finish straight is critical as it is 0.5 miles long. In taking the tighter line through the mid part of turn 17 instead of a traditional wide line with a late apex, it didn't give me the maximum possible speed onto the straight. However, the small speed I have lost (around 1mph in this example (shown in the screenshot below, 'exit') only leads to a 0.1s loss down the main straight, whereas I have gained 0.5s in the corner.

In order to maximise my speed onto the approaching finish line straight, I ensured that my left wheels reached the white concrete on the far left of the corner. The challenge was to see how close I could get to the exit wall to use all the available space and use maximum power.

As you can see by the screenshots above ('exit'), the other drivers managed to get fairly close to the wall, but it was those extra few inches that ensured my exit speed almost managed to match theirs, even though they took the deeper, slow in-fast out approach through turn 17."

Turn 17 video and data. This and all other graph and video screenshots are taken from ***RACELOGIC's* CIRCUIT TOOLS** software, included free with **VIDEO VBOX** video and GPS data loggers. It automatically recognises the circuit you are driving and compares your laps or those of other drivers. The video and data is synchronised to provide simple pointers on how to reduce lap-times.

The screenshot above, highlighting turn 17 in Racelogic's free Circuit Tools analysis software shows the whole of turn 17, and you can see the different line I took (the red trace) compared with the other drivers. You can also see the delta-T channel graph at the bottom of the screenshot, which is the lap time lost or gained through this section.

The Delta-T graph, shown at the bottom, shows where the other two drivers lost time in comparison to Nigel (shown by the red line). It's possible to see this delta time live in the car with ***RACELOGIC's* OLED DISPLAY** predictive lap timer, which connects to a **VIDEO VBOX**. The predictive lap timer takes your best lap and shows you a real time, easy to glance at graphic, showing where you are losing or gaining time.

Why the traditional cornering technique isn't always the fastest

"As you have seen, this is opposite to traditional cornering technique, and is contrary to what many experts say is the only way to tackle a corner. For the Mazda Miata track car on turn 17, the mid-corner was maximised and the entry and exit speeds were sacrificed to gain more time overall. This demonstrates the fact that concentrating your efforts on a small portion of the corner can help you gain a lot of time. To ensure you're always improving and getting faster, it's important to keep pushing the limits and challenging the conventional wisdom!

However, it should be noted that different cars do have different characteristics. The less traditional line explained above worked very well in the Miata, but didn't work so well when I was driving a Corvette Trans-Am car which responded better to going wider into the corner and straightening out the bumps.

When cars and tracks are different, with varying levels of grip and surfaces, you need to be experimental and open minded when finding the fastest route. The best way to do this is with video data logging and easy to understand analysis software that synchronises the video and data for you. This will enable you to easily pinpoint areas to improve. In addition to synchronised data I now find predictive lap timing very useful.

By using a graphical display which uses GPS position to compare my current lap with my fastest so far, I can immediately see whether a new technique or line is making me quicker or slower.

The best technique is to try the traditional, recommended line to get some feedback and a reference time, and then see if you can better it by experimenting with different techniques. You might just find other drivers beginning to copy you!"

We hope you've enjoyed reading this article, and that it has provided an interesting insight into how one racing driver approaches longer corners, using turn 17 at Sebring as an example. There are, of course, many ways to tackle a long corner, and looking at the video and data quickly shows which are the most effective!

Watch a video of the corner here: http://www.youtube.com/watch?v=x6lmeHrO3e8&tracker=False

Advanced Circuit Driving Techniques

Article 6:

Why just changing head position can increase your cornering speed

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Advanced Circuit Driving Techniques

Article 6: Why just changing head position can increase your cornering speed

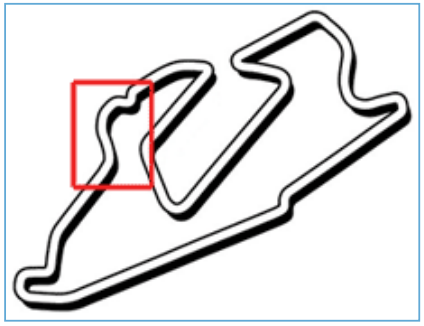
'Owl Vision', and how to use video and data to improve circuit driving

Ben Elliot (ARDS grade A Racing Instructor), has won races in cars as varied as Formula Ford, Radicals, Westfields, and Ginettas. This gives him rich knowledge to draw on when he is coaching others to go faster. In this article, Ben discusses the importance of where a driver is looking on the track, and why reading the road, visualising racing lines, and aligning head and eye movement while driving is so important when chasing lap times.

Ben Elliot: "The job of a circuit instructor basically involves identifying where a driver can improve, and showing them exactly how to do it. This involves finding where they are sacrificing lap time, analysing why, and showing them how to take remedial action.

Using video and GPS data logging enables me to back up what I am saying with objective information, and allows the driver to look at the video and data to see for themselves.

Let's take an example from a session at Bedford Autodrome, UK



I spotted that the driver, Adam, was turning too late from left to right (corners highlighted above). The late turn to the right meant a tighter turn to the apex, so he couldn't accelerate as hard through the turn and onto the following straight.

I arranged the cameras to show the circuit in the main view and the driver in the picture in picture view. In the screenshot below with me driving you can see I'm looking through the left hand bend.

Ben

Progressing a little further around the corner we can now compare the video between myself (left) and Adam (right) as we come to the end of the left turn. We both have the car positioned nicely on the inside ready for the following right hand bend.

However, take a look at the inset camera pointing at each of us and you can see a big difference.

Ben

Adam

My head is starting to turn to the right as I look towards the apex of the next corner. Adam is still looking to left side of the circuit. Those familiar with Bedford circuit will know that there is normally a yellow 'turn in' cone on the left between the corners. Adam was focussing on this point.

Moving past the exit of the left turn, you can see that I (left) have let the car run away from the edge of the circuit and am in the process of changing direction. I have gained 5mph. Adam's head (right) is now straight to his body as he looks to the apex. Adam has gained just 1mph.

Ben

Adam

At the apex Adam is now hard on the throttle as he sees the road opening up in front of him. There is now a 13mph difference between us. Both of our heads are now in a similar position, showing that Adam is looking through to the exit of the corner properly.

Ben

Adam

So how can this driver improve his technique to go faster? Let's take a look:

Identifying the fault: Adam is turning too late into the right hand corner.

Analysing why: The reason this driver is turning in late is visual preparation. Adam is looking for a turn in point for the right hand bend and then looking for the apex once he arrives at the turn point. I call this 'Cone Spotting'!

His lack of head movement suggests that Adam is looking to the right by turning his eyes and not his head. By doing this your nose blocks your outer eye and you get reduced depth (and therefore speed) perception.

Remedial Action: I was watching Adam do this in the car and on subsequent laps worked with him to improve his use of vision. The real breakthrough, however, came in the debrief. Adam could see the differences in technique but genuinely had no idea that he was doing this in the car.

It's sometimes necessary to forget about the turn in point between two corners and immediately move your vision to the apex of the right hand bend as you're exiting the left (as I am doing) You can still use a turn in point as a reference but try to spot this in your peripheral vision, not focus on it.

For right hand bends you also need to keep your eyes ahead and turn your head towards the apex. I call this 'Owl Vision'.

Looking at the speed and lap time difference graphs at the bottom of the circuit tools screen is very useful when finding the big areas where lap time can be improved, but video adds another dimension to the analysis.

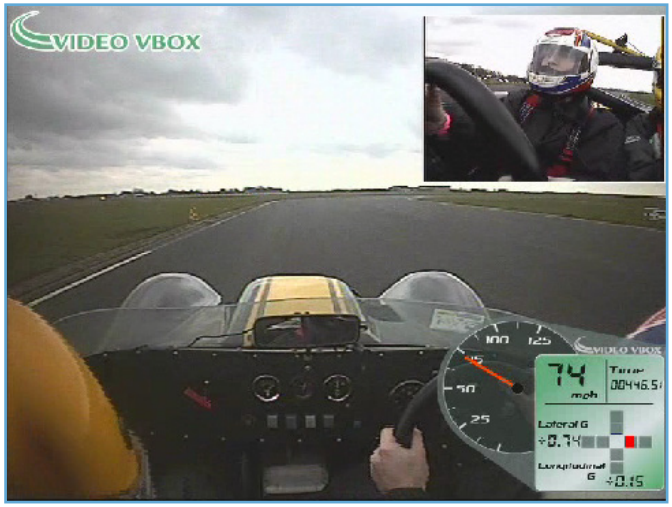
With the right equipment and driver focused software, it is very easy to compare two drivers and work out where time is being gained or lost.

The benefits of 'Owl Vision' include:

- Better speed perception
- Increased sensitivity to oversteer / understeer
- More consistent driving.

So, after having seen the video and worked on this technique, Adam is now turning his head to look into the corner and is preparing to turn in. This means he carries a huge 11mph more speed through the corner than he was able to earlier in the day.

Looking at the video and embedded data has helped Adam's corner preparation to improve dramatically.



How does video data logging help in cutting lap times?

Normally I sit and watch the driver as they go through the corner. I can give feedback, but getting a driver to believe they are actually doing it is sometimes quite hard! Video gives the customer a clear demonstration of the differences in technique and speed.

I am a firm believer in the saying 'a picture tells a thousand words'. Video effectively allows the driver to teach themselves, and allows me to give useful tuition in less time than giving a description. Drivers always improve at a higher rate as a result of looking at the video and data, and I can therefore get more teaching done in a day which raises the value for money of my tuition.

By using a **VIDEO VBOX**, you can monitor your driving progress and improve at a faster rate. It's much easier to assess your performance by watching it afterwards than whilst driving!"

Advanced Circuit Driving Techniques

Article 7:

Pro vs. Pro:

Finding lap time gains in the most unlikely places

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Advanced Circuit Driving Techniques

Article 7: Pro vs. Pro – Finding lap time gains in the most unlikely places

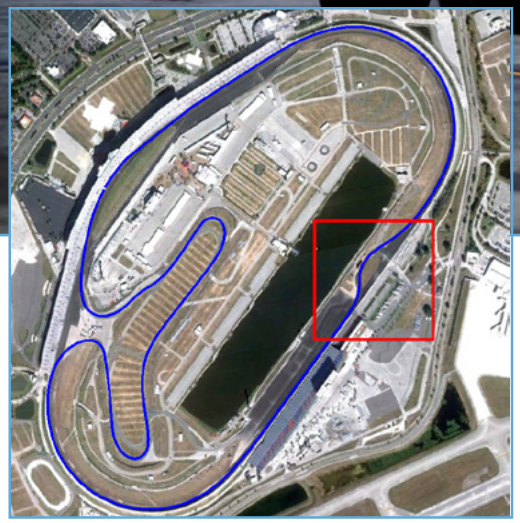
Nigel Greensall on why a corner sometimes isn't a corner.

"You're driving a Porsche GT3 RSR at 168mph around the banking of Daytona International Speedway. You're approaching the chicane. When do you brake? How hard? On a recent test day with a two times Porsche Supercup Champion, I realised our techniques were very different and that it was possible to gain time in an unexpected way.

Daytona is famed for its 31 degree banked corners, enabling NASCARs to exceed 200mph. The bus stop, half way along the back straight on the 24-hour circuit configuration, is often overlooked by drivers who see it as a standard two-corner chicane. I thought I'd compare my technique with the other pro driver to see if I gained any time using a different approach.

After all, even the best drivers in the world compare their data with team mates in order to go quicker. For example, F1 driver Mark Webber famously used Sebastien Vettel's data in order to find 0.5 seconds in sector two at Abu Dhabi whilst he was fighting for the world championship.

For the most accurate comparison, the other driver and I drove the same 2011 Porsche GT3 RSR Grand Am Spec race car.



Looking at the GPS and video data there was no difference in the lines we drove or our sector times around the circuit, except for the bus stop chicane. This seemingly insignificant section enabled me to gain 0.3 seconds. How? Let's take it from the approach ...

Figure 1 The Approach. As shown by the comparison video and data left (I am on the left, with the red border), both of us have the same speed at the end of the banked straight. However I am closer to the wall, which opens up my entry into the left-hander.

As you can see from figure 1, we are both travelling at 168mph as we approach the bus stop. (My video is on the left, and my data is the red line). The speed trace graph below the screenshots and the delta-t graph below that (showing difference in lap times in as we progress around the circuit) shows almost identical performance until this point.

The only difference now is in track position - I am edging the car closer to the wall. This opens up my entry to the left-hander and enables me to carry more speed. Steering right towards a concrete wall at 168mph whilst looking to a left turn ahead takes some getting used to, but track position is the key to speed. You might think you are making full use of the entire width but it's important to look back at your video and data to see if you really are.

Figure 2 Apex of bus stop left-hander. I am using slightly more of the kerb and carrying 9mph more speed

The braking zone

It is usually in the early part of a corner that the most gains and improvements can be made and this example is no exception.

The extra speed I have been able to carry by getting as close to the wall as possible before turn in has paid off when you look at figure 2, showing the first apex of the chicane. As shown by my video in the left screenshot, I am also making more use of the kerb, straightening out the corner as much as possible.

But the crucial element is trail braking, which enables me to hit the first apex at 97mph. The other driver braked in a straight line before the bus stop. This brought his speed down to 88mph, as he treated the chicane as two corners and coasted between them. However I am looking at the whole section up until the second apex as a braking zone, modulating my brake force as the car rounds the corner.

As I come down the straight and turn towards the first apex I apply the brakes at 100% pressure, then reduce the force to 30% to keep the car balanced (keeping on the brakes hard on the approach to the corner would spin the car), and then increase the pressure to 70% ready for the second apex.

As you can see by the delta-t (the bottom graph in figure 2) I'm beginning to make a gain here, as the blue trace of the other pro driver shows an increase in time in comparison to my red trace.

Figure 3 Entry to bus stop right-hander. Look at the g-force trace (the bottom graph). I am now braking heavily to scrub off the extra speed, whereas the other driver is coasting

The bus stop

The trail braking technique compared to the traditional method is clear when you look at the G-force graph in figure 3. As you can see by the red trace, I apply the brakes hard at first, reduce the pressure for the first apex, and then increase the pressure again before the second apex of the bus stop – bringing the g-force to 0.7G.

The other driver (the blue trace) hits the brakes hard before the bus stop, but then coasts around the chicane at just 0.2G of braking force, having missed the opportunity for extra speed in the first section.

Leaving the bus stop

On reaching the second apex of the bus stop the gains made by the extra speed carried through the first section are now clear from the delta-t.

When a corner isn't a corner

As a driver you would usually see the chicane and brake for it as a normal left followed by a right. But this can mean braking too early. The second apex requires less speed but this doesn't mean you need to get down to this speed the corner before – a quicker lap time results in taking the speed off as close to the right hand corner as possible without coming off your line.

The key point is that I don't look at the bus stop as a traditional chicane, but more as a right hand corner with a curved braking zone. This means I scrub off only as much speed as required to get round it, and then continue the braking for the right-hander.

Of course, these techniques aren't just limited to the bus stop at Daytona. Any circuit featuring two corners close together is ideal for trying out this trail braking technique for a higher apex speed. The Knickerbrook chicane at Oulton Park and the chicane at Anglesey Coastal Circuit in the UK are comparable, as is Des Fagnes (Pif Paf) at Spa Francorchamps.

When you look at a track map don't necessarily accept the traditional approach as the fastest. Try to see where the important sections are, especially those that may appear to be insignificant. You can then use video and GPS data to look at your data and see where gains can be made, particularly when you compare with another driver."

Figure 4 Apex of bus stop right-hander. We now have similar speeds, but look at the delta-t channel at the bottom: I have gained 0.3s in this short section

"When you look at the track map, this section of Daytona appears to be fairly insignificant. But it's homing in on areas like this that enables you to find gains you would never expect."

Advanced Circuit Driving Techniques

Article 8:

How to use predictive lap timing for real time improvements

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Advanced Circuit Driving Techniques

Article 8: How to use predictive lap timing for real time improvements

Learn how predictive lap timing is used in racing for instant driver feedback, as used in VIDEO VBOX with the OLED predictive lap timing display

Real time feedback to the driver is becoming increasingly important in racing, to help evaluate driving lines and vehicle set-ups whilst out on the circuit and get the most out of valuable track time. As GPS technology becomes more and more reliable, predictive lap timing becomes more accurate and useful.

What are predictive lap timers?

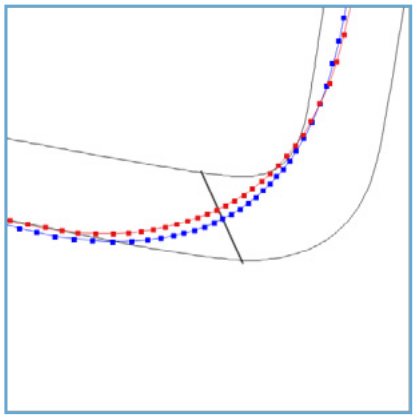
Predictive lap timing is nothing new, and has been around for some time on many high end data logging systems. The ability to see if your current lap is quicker or slower than your fastest, in real time, is invaluable for driver training.

It enables amateurs to see where they're losing time and try out different lines and braking points, whilst pros can verify that the lines they are using are indeed the fastest. Real time comparison also saves a lot of time and money in vehicle set up.

However many existing systems are expensive. And because most use rolling distance around the lap (gathered from a wheel speed sensor) as a reference to compare two different laps, they're not very accurate either. They rely on the line the driver takes around the lap being very similar; otherwise the alignment will get progressively worse as the lap unfolds. Sometimes this method works, but when a driver wants to try a different line, overtakes another car, or locks a wheel, it's difficult to get a meaningful alignment. The longer the circuit, the more the margin of error increases.

Predictive lap timing using GPS

A better solution is to use the GPS position from a fast updating data logger to align the two laps. Whilst GPS position may only be accurate to a few metres, a typical average race speed would be well in excess of 30m/s, minimising any errors to around 1/10th of a second.



How much more accurate is GPS?

To see how this can help in the analysis software, we can take the two best laps during a race from a professional driver around the 1.6 mile Silverstone National Circuit in the UK.

The rolling distance variation was 11.6m even though the lap time difference was only 0.06s. This equates to an analysis alignment error of 0.3s, and this is around a very short track, with a very good driver. On a longer track with a less consistent driver, this error can easily grow to over 1s!

However, by using GPS position, the timing error between these laps is virtually eliminated. GPS means that the time can be kept accurate to within 1/10th of a second.

'LineSnap': Predictive Lap timing using GPS

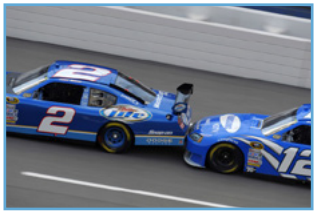
After over a year's development, we've developed a new feature we call 'LineSnap'. Rather than distance, it uses GPS position to accurately align two different laps, 10 times a second. This offers unrivalled accuracy, even if the driver takes a completely different line each lap. The system will maintain 0.1s precision the entire way around any circuits, including very long circuits such as the Nurburgring or Spa.

VIDEO VBOX PRO with 'Linesnap' predictive lap timing

The technology has been built into our high brightness OLED dashboard display, which can be connected to the **VIDEO VBOX** product range.

It provides drivers with accurate, real-time lap comparison, and it works at any track. You do not need any external beacons, and there is no setting up required.

It adds another element to data logging, as drivers have a real-time comparison of their current lap against their previously recorded best lap – so they will always be trying to beat it. It means they can judge the effectiveness of different lines and get immediate feedback on the graphical display of how much time they're losing or gaining. It's becoming popular with race teams and individual drivers too.



Bump Drafting and Slipstreaming

Nigel Greensall, professional racing driver and coach, says: "The real time nature of predictive lap timing makes it great for honing racing skills and getting an immediate impression of how much time you are losing or gaining.

It's good for working on techniques such as slip-streaming, because slight adjustments show up immediately in the display. It's also invaluable where there are a variety of different lines that you can take. On the banked HomeStead Circuit at Miami, I was able to see instantly which line along the long banked corner was quickest"

Using the OLED predictive lap timer

RACELOGIC'S predictive lap timing really does beat the alternatives, for two reasons. Firstly, it stays accurate all the time, and secondly, the display is nice and clear, so it's easy to glance at on your dashboard. It is also useful in races where testing is limited, as it means you don't need to keep going back to the pits to analyse the data. This enables you to be even more adventurous with the lines you use.

Drivers and teams at any level can quickly see where time is lost – so you can make big gains in consistency. It gives drivers the confidence to try different techniques and lines, and then see the instant feedback.

Cost and time savings in race car development

Instant feedback is great for race car development too. For example, the driver can give the engineers in the pits real feedback on how the car is performing with different set ups, compared in real time to previous set ups. Engineers can prepare new set ups whilst the car is out on the track. This speeds up car development, bringing down the level of trial and error that often occurs.

The future

For instant feedback on driving technique and line, this kind of predictive display can't be beaten. As prices for this kind of equipment have fallen, displays such as these will become an essential tool for any driver, professional or amateur, keen on improving lap times.

Using Racelogic's Predictive lap timer

The OLED predictive lap timing display is designed to connect to a **VIDEO VBOX** GPS and video data logger. A key advantage of **VIDEO VBOX** over rival systems is that it is a one-box solution, combining a multi-camera video recorder, GPS data logger, and real-time graphic overlay into a single unit. Racers need to be sure that a video system is easy to use, quick to install, and above all that it can function reliably in the demanding conditions inside a race car.

VIDEO VBOX is small, flexible, and reliable, with automatic power back-up to ensure data is never lost. It also has automatic logging that can be set to start over a certain speed, meaning that drivers don't have to think about switching it on in the heat of the moment.

What other ***RACELOGIC*** products are suitable for predictive lap timing?

Firstly released as part of **RACELOGIC's OLED DISPLAY** and **VIDEO VBOX** range, the new Predictive Lap Timing upgrade has now also been launched as a free firmware upgrade for ***RACELOGIC's PerformanceBox*** and ***DriftBox*** GPS data loggers. **RACELOGIC** claim that this makes them the best value predictive lap timers on the market – with a starting price of just £299+VAT.

Advanced Circuit Driving Techniques

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Article 9: Finding time in the wet

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Advanced Circuit Driving Techniques
Article 9: Finding time in the wet

Using a predictive lap timer to go faster in the wet

Driving quickly on a wet track sometimes requires a very different technique compared with driving in the dry. Depending on the track, the quickest line through the corners may differ substantially from the accepted dry 'racing line'.

The wet line myth

It is often quoted that the racing line becomes coated with rubber and oil which makes it more slippery in the wet. However plausible this sounds, it is in fact a myth and here is why:

When asphalt is first laid down, there is a uniform roughness to the surface. Over the years, as many cars pass over the same piece of road, the sharp ridges and peaks in the road surface become worn down to a smooth surface.

Close up of tarmac worn smooth after 8 years of heavy use

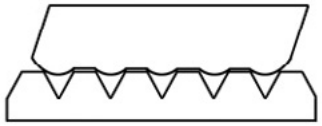
If you look next time you are on track, (assuming it is sunny!) you will see that the track surface on the racing line is 'shinier' compared with the rest of the track.

Off the racing line, it is the sharp ridges and peaks which yield greater grip in the wet than the smoother, more frequently used parts of the track.

Why is this?

The two dominant forces affecting the performance of a tyre are adhesion and deformation. Adhesion is the chemical 'stickiness' between the tyre and the track, and deformation is the force which results from the rubber changing shape to fill in the gaps in the surface.

With adhesion, the more direct contact there is between the tyre and the track, the greater the force.

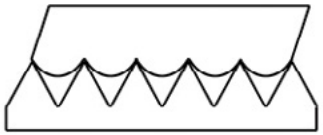


Smooth surface

Good adhesion + Poor deformation

= good grip in dry

With deformation, the more distortion of the tyre there is, the greater the force.



Rough surface

Poor adhesion + Good deformation

= good grip in wet

Adhesion generally has a stronger effect than deformation, so in the dry, once the tyre is up to temperature, a smooth surface will generate better grip than a rough surface.

However, a wet surface prevents direct contact between the rubber and the surface, completely blocking the formation of the adhesive forces that work best on flat surfaces. Therefore, in the wet, a rough surface can generate far more grip by increasing the deformation of the tyre.

Another important factor is the tyre temperature, as cold tyres have inherently less grip than warm tyres. In the wet, it is often difficult to get tyre temperatures high enough to give good grip.

How to find the wet line (or wettest line)

Unfortunately, there is no magic formula to working out the 'wet line' through a corner, the only way is through trial and error, and this is where a predictive lap timer becomes an essential part of the process.

Here are some tips from Nigel Greensall, (highly experienced driver coach) on finding the grip on a wet and slippery track:

- **Get some temperature into the tyres**
  I find it is important to work the tyres hard straight from the pits. I try and slide the car around to move the tread blocks about to generate some heat. However, there is no point trying to do this on the greasy parts of the track, as you won't be able to generate enough g forces to have an effect, so I drive around the edges of the track trying to find some grip.

It is only once the tyres are up to temperature that you can properly begin to find what the quickest line will be.

- **Brake offline**
  The track is often very smooth in the braking zone, so I sometimes try braking slightly towards the inside of the track to maximize the grip.
- **Turn in later**
  I avoid the normal turning in point, and attempt to drive just round the outside of the normal racing line, leaving a later turn in than as normal. I then turn more sharply than I normally would in the dry in order to get the car pointed up the next straight as early as possible, and get on the throttle as soon as possible. Slow in, fast out.
- **Straight line the slippery bits**
  Of course, at some point you have to cross the slippery racing line, so that is also why you should try and be as straight as possible to avoid any wheelspin. Spend as little time as you can accelerating on the slippery part of the track - try to 'float' across it - and avoid the exit curbs, if at all possible.
- **Use a predictive lap timer**
  A predictive lap timer displays the difference between your current lap time and your previous best. A positive number means you are going slower, and a negative number means you are going quicker.

I reset the display just before I leave the pits, and then I try a number of different lines around each corner, watching how much time I gain or lose. As I enter the corner the display may be reading +0.50 which means I am 0.5s slower at that point, but this doesn't matter as I am only looking for a change in value.

A predictive lap timer in position and giving immediate feedback

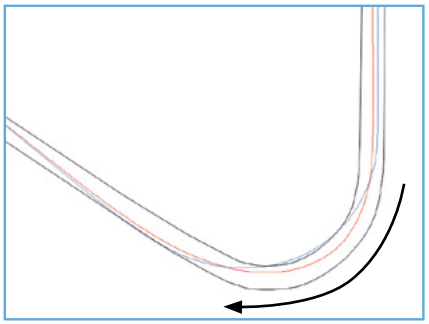
As I exit the corner it may then display +0.25, which means I have gained 0.25s in that section. This works on a corner-to-corner basis, all I have to do is glance at the readout just before I turn in, and then once again as I exit. The key point is that I don't need to wait until the end of the lap to find out if my new approach to that corner has worked.

A **VIDEO VBOX LITE** with predictive OLED

In this way, over three or four laps I can quickly build up a picture of where the grip can be found, and then string these pieces together to produce a quick lap. When you then sail past other people on the track, they are often left wondering how you managed to drive clean round the outside or even up the inside of them whilst they are slipping and sliding around!

Continued on next page.

Take the following example from Tower corner at Croft:



Wet line red, dry line blue

On my wet lap, I approached the corner in the middle of the track, and then turn in much later, deliberately missing the apex to drive on the grippier part of the track. At the same time I am trying to get on the throttle as early as possible and straighten my exit trying to avoid the slippery exit of the corner by the curb.

S-bends

On S-bends or chicanes, I tend to use more or less the same line as in the dry. This is because to drive on the grippier parts of the track in these situations requires a lot of deviating backwards and forwards across the slippery racing line, which ends up being slower.

Another fascinating example comes from the FunCup round at Croft where Nigel was coaching Julian Thomas the day before the race.

Julian: "It was the end of a wet test session, and I was slowing down on my in-lap when I turned into Hawthorn a little bit slower than normal. Immediately I felt more grip, allowing me to take a much tighter line than normal, and I saw the OLED display start to rapidly count down. By the time I reached the chicane I had gained 0.54s! You could certainly feel the extra grip on this line, but for it to be worth this much time was quite surprising. In fact, when it rained in qualifying the next day, I used this new line and managed to set the fastest lap in my class by 0.6s, setting my first pole position!

Watch how Julian saved 0.54 here:
http://www.youtube.com/watch?v=73DjI2guKbI

An example of this is the chicane at Croft, where the wet line and dry line are virtually identical.

We hope you've enjoyed reading this article, and that it has provided an interesting insight into how you can gain time in the wet using a predictive lap timers.

This effective device gives you immediate access to information to help you go faster.

Predictive lap timing is nothing new, and have been around for some time on many high end data logging systems.

However, many existing systems are expensive. And because most use rolling distance around the lap (gathered from a wheel speed sensor) as a reference to compare two different laps, they're not very accurate either.

A better solution is to use the GPS position from a fast updating data logger to align the two laps. Whilst GPS position may only be accurate to a few metres, a typical average race speed would be well in excess of 30m/s, minimising any errors to around 1/10th of a second. By using GPS, **VIDEO VBOX LITE** incorporates the technology you need to go faster. All data and video in this article was recorded with **VIDEO VBOX LITE**.

More information and the online shop is available on vboxmotorsport.co.uk

Advanced Circuit Driving Techniques

Article 10: Landmark Decisions

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Advanced Circuit Driving Techniques
Article 10: Landmark Decisions

Any good driver will tell you that you can only go genuinely fast when you are in a calm state of mind, and in rhythm to the flow of the track. Knowing your way around a circuit comes with time spent on it, but endlessly circling without breaking it down into its key elements and understanding them isn't going to lead to rapid progression.

So how do you become a calmer driver when the scenery is rushing at you so quickly?

What's needed is to take the guesswork out of the equation, and this is where reference points, or landmarks, become essential. The braking point is the most crucial, and if you get this spot on, then the rest of the corner should flow nicely.

Learning to recognise them is a skill as important as being able to drive to them, and driving to them - within your peripheral vision - is the key to precision. Precision is the key to speed.

You might only spend a small proportion of your time in a race car, and when you do venture out on track it can feel overwhelmingly fast. Landmarks help in processing all the information you are receiving – you want to be confident that you are able to put the car in the right place, on every corner, during every lap.

Nigel puts in a few benchmark laps in the Caterham SP300R.

Landmarking is Nigel Greensall's starting point with anyone he teaches: "I find that those I coach who are able to take on board and use landmarks will become more consistent, and more precise. It allows for a much higher level of relaxation and gives them the ability to think about other things – such as what the car is actually doing. And simply, it helps in learning the circuit more quickly."

When Nigel coaches his clients, the first thing he will do is to set out where the landmarks are...

Nigel and his client Jonathan get to work between sessions at Silverstone, by examining the reference points that Nigel wants Jonathan to learn.

"I'll start the process by driving a few laps first, so that afterwards - using Circuit Tools - we can break down the circuit into individual landmarks. (One tip: use landmarks that will always be there – like the end of a barrier, or a bridge. There's no point in choosing a shadow across the track or a service vehicle parked behind the Armco – they're not permanent, and using such features could end in disaster!)

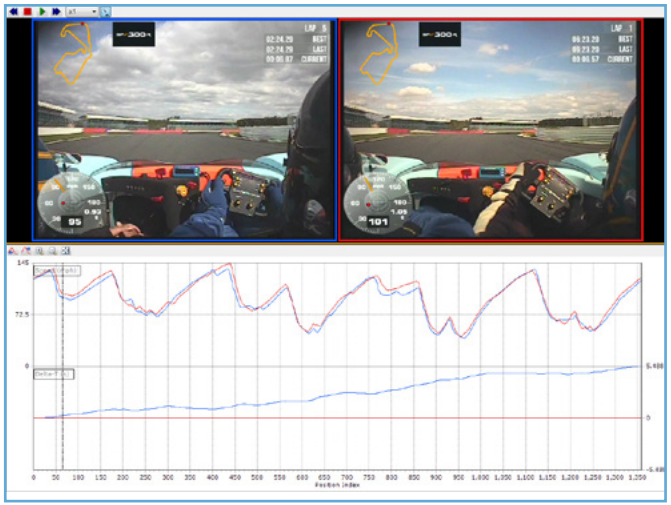
"Once they've been studied and understood, the client will go and drive some laps of his own – but not quickly. I need him to concentrate on the landmarks before going faster – only then can a benchmark lap time be logged, and we can start to look at ways of improving it.

"Let's take a look at Copse Corner, Silverstone, and an example of what happens when you miss your reference points.

"Firstly, braking. The red-bordered video and graph trace is me, the blue is my client. Note how I have braked just before the first turn marker, but Jonathan has done so some forty-seven metres earlier. This is the first missed landmark, and as we will see it has a marked effect on the others.

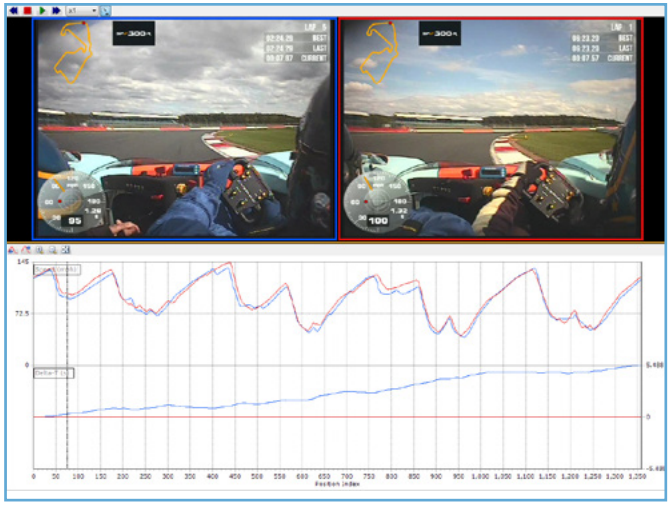
Using the turn marker as the brake point for Copse Corner.

"Next, the turn-in. Look at the amount of steering input I have initially applied – it's a lot more than Jonathan's, and I am heading directly for the apex of Copse Corner:



Nigel applies sufficient lock to turn decisively towards the apex.

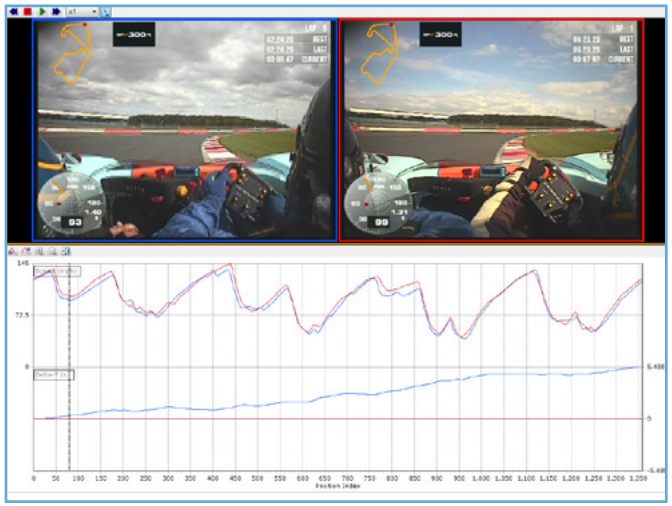
"A little further towards the apex and Jonathan realises he's not going to hit it – and applies more lock in an effort to do so:



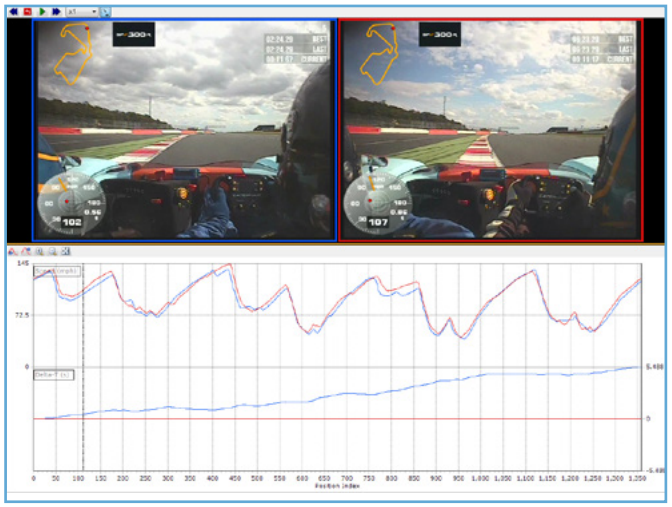
Nigel makes the perfect approach to the apex, now without much steering lock, so the car is nicely balanced.

"This has a detrimental effect, both on the car and on the driver: note the amount of g-force – almost identical, and yet Jonathan is travelling 5mph slower. This means that in terms of grip, the car is just about at its limit but not actually going as fast as it could be – the additional steering input causes this. He is having to work harder and ends up enduring greater amounts of stress as he attempts to rectify the mistake… the result is a car and its driver at the limit, not actually going as fast as it is possible to go.

"Once we are on the apex, the result is clear: I have hit it, Jonathan has not. Note again the amount of g-force and the disparate speeds: 1.4g and 93mph (blue trace) against 1.3g and 99mph (red trace). In my lap, the car is going significantly faster yet is more within its limits of mechanical grip":



The red trace is showing a faster apex speed with less lateral acceleration than the blue trace.



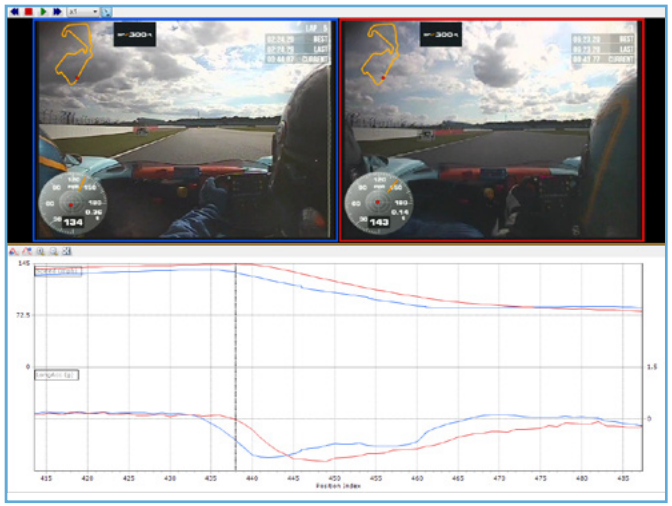
"Now as we look at the exit, you can clearly see that the extra speed I am carrying has taken me much further over, but on a circuit as wide as Silverstone this isn't an issue and I am going 5mph faster. Bear in mind that with the new MSA track limits rules in 2014, this particular manoeuvre may not be allowed!

"To summarise this particular example: through Copse Corner I have gained half a second simply by driving precisely to the landmarks. This forces me to use the full width of track, allowing me to achieve faster cornering.

"Advice to drivers is always: "Use all (allowable limits of) the track" – which in itself is perfectly correct, it just doesn't go far enough. By breaking it down to its constituent parts, however, this rule can be more easily applied."

Looking a little further into the lap, we can gain further insight into the importance of using landmarks to help the flow of the car through a corner – this time at Stowe.

Firstly, Jonathan brakes too early: only four tenths of a second earlier than Nigel, but in that time Nigel travels an additional 25m before he applies the brakes:

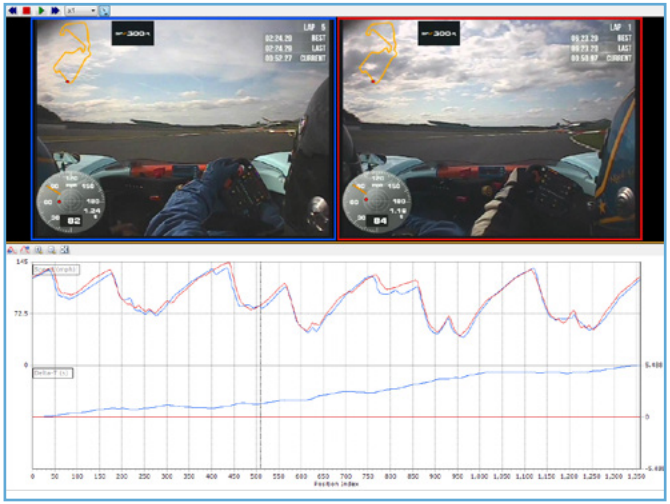


In this screenshot we have zoomed in on the graphs and turned on the Longitudinal Acceleration channel. At this point, Jonathan is applying 0.6g of deceleration but Nigel has only just started to brake, so the car is going to be slowed too soon before the Stow turn-in point.

Consequently, Jonathan begins turning too early, causing him to head towards the apex sooner than Nigel: if he had hit the right braking point, then he wouldn't be tempted to turn in too early. At this point you can see that Jonathan is in fact travelling 3mph faster than Nigel. This is because - realising he's turned in early - he feels the need to accelerate towards the apex:

The early braking has led to an early turn-in towards the Stowe apex.

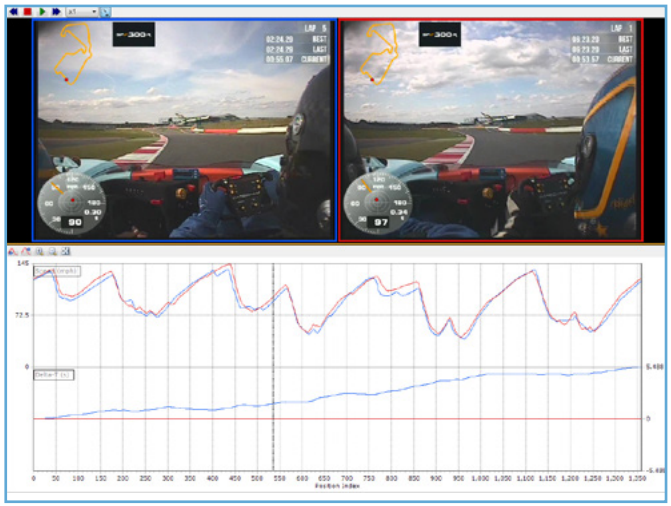
However it leads to the car running wide on the exit and with a lot of steering lock applied, requiring a lift off the throttle, resulting in an instant loss of speed:



The early apex and subsequent additional steering lock required to keep the car on-line results in a loss of exit speed – just where it is most critical.

The result is that three seconds and just over 100m later, Nigel is going 7mph faster.

Nigel: "Stowe is interesting. Yes, you are going very fast down Hangar Straight, but you don't actually have to brake as hard as you would imagine at the end of it, because the track rises slightly just before the corner which naturally helps to slow the car.
With the right reference point you will avoid braking too early, which almost always leads to turning in too early."



The faster exit speed out of Stowe corner pays big dividends in the short straight before Vale.

It is worth noting this analysis of the approach to Stowe: "When you examine the track, think about each section. Where is it off camber? How will elevation changes help or hinder you as you brake and accelerate? Develop a mental map of which bits of the circuit will aid you, or make you do something differently, and then catalogue them next to your landmarks. Doing this makes them much easier to remember rather than trying to understand it all in one go."

Decoding a New Circuit

So what process does Nigel follow when he goes somewhere new? Navigating around an entirely unknown circuit for the first time, picking out the landmarks that will result in good lap times, is a skill honed through many years of constant race experience and comes as second nature to him; but as mentioned above, there are ways you can go about doing the same.

To gain an insight on how he decides for himself what landmarks to use, we can study some footage recorded in a Ridley & Scott MKIIIC at The Circuit of the Americas, Texas.

The video has been recorded using VBOX HD, and the additional clarity this lends is a bonus when studying reference points.

"The track in Texas is very undulating, with a lot of blind apexes, making reference points difficult to see far in advance. However there were some landmarks that I was able to use to good effect.

"The braking point on the long back straight, for instance: I found that it was just where the kerbing on the right transitioned into the rumble strip. The corner is quite a way in front, so it was easy to concentrate on simply hitting 'my' brake marker before dealing with the approaching left-hander:

The very long back straight at the Circuit of the Americas. As you can see from the speed there's a long braking zone, so Nigel was able to accurately hit the brakes without fear of running out of thinking time before the corner.

"A lot of the corner apexes are hidden at Texas. This is one, turn three, and it's important to hit the apex absolutely right because it leads onto a series of very fast turns. To get the apex every time, I made sure to start turning just before the Patron bridge:

Completely blind apex at turn three. If you wait until you're under the bridge and can see it, it will be too late and you will completely miss it.

"Although I couldn't see the turn three apex, turning just before the bridge meant I could accurately drive over it:

Turn Three Apex: note the loss of only 3mph from the turn-in point to this apex, so a very fast corner. Getting this one wrong will result in a big time loss, so it was important for Nigel to establish the correct place to turn in, ensuring a correct apex each lap.

"Turn ten is similar: it's very fast, but absolutely blind. A lot of drivers would go on here and turn too late, losing lots of time.

The approach to turn ten. The apex is only about 140m away at this point but is completely obscured from view.

"But by aiming for just right of the Armco, I could take it flat out in fifth gear:

The end of the Armco barrier became Nigel's landmark, turning towards it as soon as it came into view.

"In this corner alone I was one and a half seconds faster than my co-driver. It's an absolutely classic landmark which, once I'd started to make use of it, not only gave me a huge racing advantage but also a great deal of confidence. I knew I was going to nail that apex every lap at about 120mph:

The apex at turn ten – note from the speed readout that Nigel has gained 16mph since the last screenshot, and that if you were only viewing the graph data you wouldn't know there is a corner here at all. Because Nigel realised that his landmark here was the end of the Armco, he swiftly gained an advantage on a lot of the other competitors.

"When I go somewhere new, I'll try to see what other drivers have done. At Texas, turns sixteen, seventeen, and eighteen all lead on to one another and, really, it is one compound corner - with what at first glance look like four possible apexes. But which ones do I hit? Or should I be hugging the inside of the track all the way round?

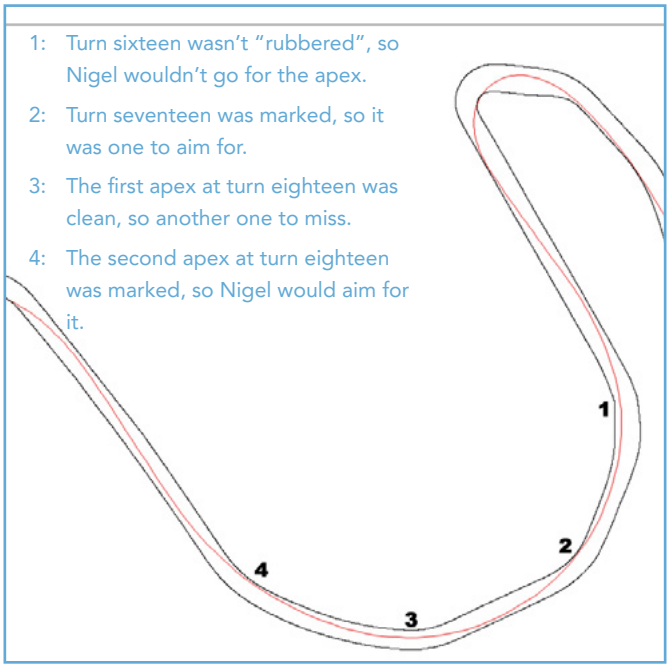
"To determine the correct line, I looked at the amount of rubber on the kerbs. The first apex at turn sixteen, there was hardly any – so no need to go right on top of it:

"At turn seventeen, there were plenty of tyre marks, so I made sure I hit it:

"Turn eighteen is made up of two apexes. On the first where wasn't much rubber on the rumble strip, so it looked like it wasn't a crucial apex to aim for:

"But the second apex was marked, so I would hit this:

"And you can see on the track map the two apexes I would hit and the two I would leave:



This is a method I will employ when I'm not certain of the best line to take. I look for the one that everyone else has been driving and see if it works for me – clues like this are invaluable in quickly decoding the quickest way around the track."

In summary: recognising race track landmarks, deciding what each one denotes, and then using them precisely as you drive, is a basic skill but a very important one. Breaking the circuit down into corners, and the corners into landmarks, allows for analysis in bite-size chunks that will help with relaxation and precision as you learn the circuit. Once the landmarks are learned, they become familiar within your peripheral vision and allow you to find a rhythm whilst you drive that then leads to experimentation in other areas, and a greater understanding of what the car is doing.

Watch Nigel in action as he coaches his client Jonathan Davies at Silverstone in our **VBOX Motorsport** video:
http://vboxmotorsport.co.uk/landmarks

Advanced Circuit Driving Techniques

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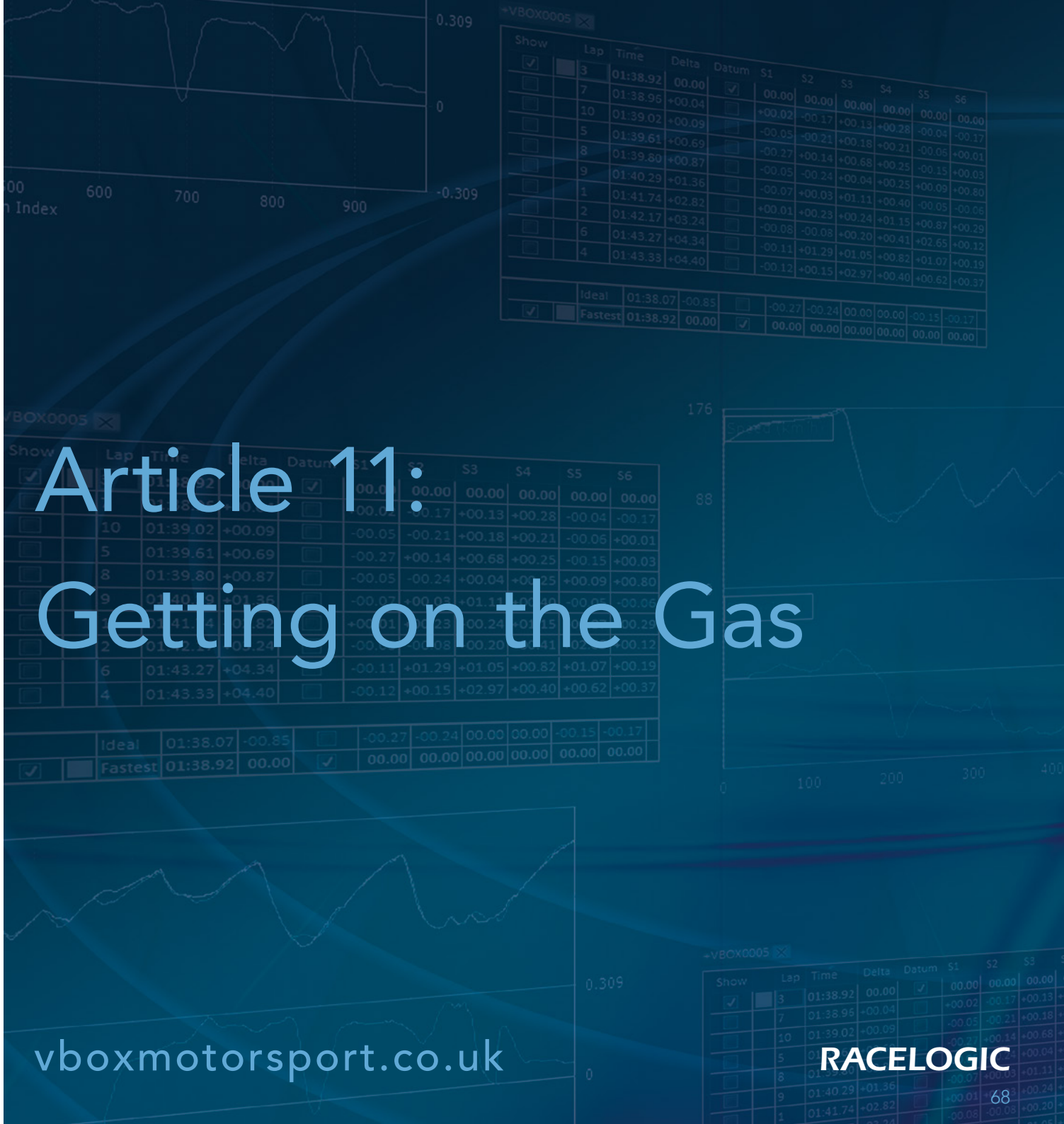

Article 11: Getting on the Gas

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Advanced Circuit Driving Techniques

Article 11: Getting on the Gas

In this article, Ben Clucas – Grade A ARDS Instructor, former Australian Formula 3 champion, and racing driver with over a decade of experience in a wide variety of cars – takes us through the importance of correctly timing your throttle application.

"A common question I'm asked by clients is: "When is the right time to get on the throttle?"

To quote 3-time Formula 1 world Champion, Sir Jackie Stewart:

"Don't put your foot on the gas pedal until you're sure that you'll never have to take it off again."

This answers the question perfectly but it needs some explanation and analysis.

90% of the time my students are getting on the throttle earlier than me, but once we start viewing the Video VBOX data in Circuit Tools, we find that their corner exit is slower than mine. Why is this happening?

If you pick up the accelerator too early, often you aren't able to get onto full throttle for a long time, and therefore at 100% of accelerator position late. Assuming you are not able to break traction, once you pick up the power you shift the weight towards the rear of the car and this often causes understeer. If you get on the power too early in the corner, when you still have quite a lot of turning to do, the car will begin to understeer, making you run out of circuit on the corner exit.

This will either cause you to lift off the throttle (which can often result in a spin or 'moment') once you realise you are running out of room, or take a long time to get to full throttle. This means that someone who possibly gets on the throttle slightly later but who is able to go very quickly to full throttle and stay on full throttle, invariably gains time on the corner exit."

What causes someone to want to get on the power too early?

"We have all heard the old adage "slow in, fast out", but I actually I find this is often not the case.

Invariably the reason a driver wants to get on the power too early is because they have entered the corner too slowly. Because of this, where a driver decides to brake often has a huge impact on where they start getting on the power, hundreds of metres later. If you brake too early, or hold on to too much brake pressure in the final 1/3 of the brake distance, it is natural to feel too slow between your turn in point and your apex. If you feel too slow at that point, the only thing you can do to try to remove that feeling is to speed up, by getting on the power. The problem is that by doing this with a lot of the turn still to do, you cause understeer, run out of track, and almost always have to back out of the throttle to a certain extent.

If you find yourself getting on the power too early, you have probably ended up losing time on the entry by braking too early or hard, been slightly too quick mid-corner, and then lost time on the exit by having to back off the throttle. The best thing to do is examine your corner entry and see if you think you are able to brake later or carry more speed in. In my experience, if you are going fast enough on corner entry, the last thing you are thinking about is getting on the power too soon!

If you think your corner entry is correct, then it may be a case of just being more patient at the apex. Sometimes it can be hard to sit for what feels like an eternity, doing nothing, but in reality is only actually a few tenths of a second. You might well find you reap the rewards of that bit of patience at the apex down the following straight!"

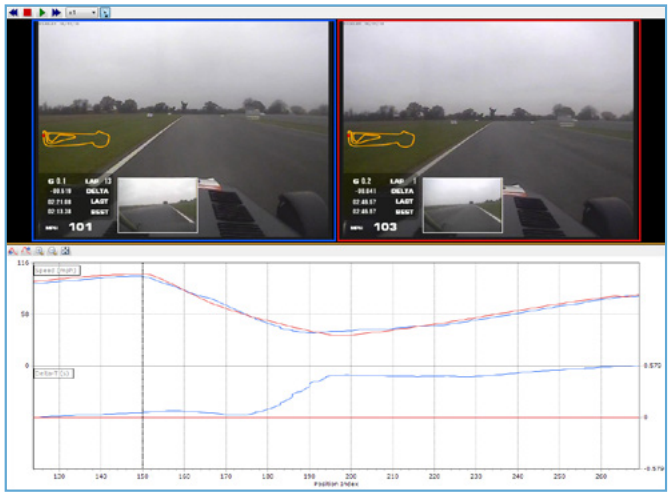
BEN CLUCAS
RACE TUITION

www.benclucas.co.uk

Example

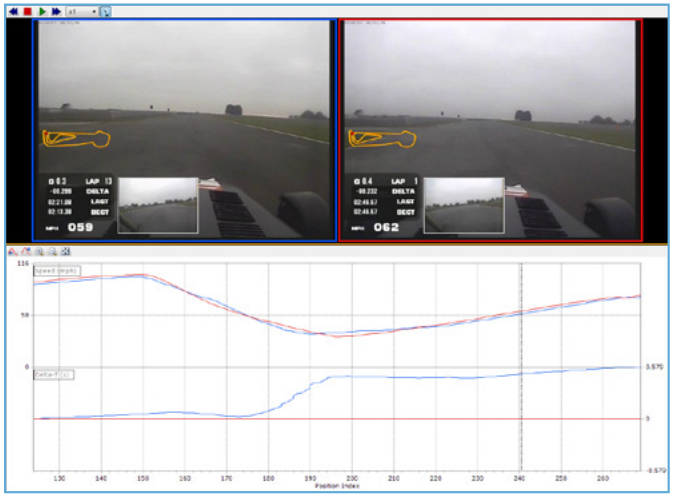
The data and video is taken from a coaching session at Snetterton, on the 300 circuit. Ben was using a Video VBOX Lite fitted in a Caterham Supersport. Ben is the red trace whilst his student is the blue.

"As we approach Montreal (turn 2), I brake about 0.15 seconds and 10m later. This gains me 0.05 seconds":



"I release brake pressure earlier, giving me more entry speed but later throttle application, gaining me 0.4s seconds":

"Despite being later on the point of applying throttle, I get to full throttle sooner, so exit the corner faster, resulting in a further gain of 0.15 seconds":



Using the same data and video, we can examine how this throttle application affects the lines taken through the corner.

"Corner entry: go into too slow and you will be tempted to get the power on too early. Although I'm still braking, I have released a bit of pressure so I can carry more entry speed. Here I am 5mph faster as we approach the apex, meaning I won't want to get on the throttle early":

"Mid-corner. You need to be patient here until you can get on and stay on the throttle. I have not yet got on the power, making my approach tighter to the apex, thus straightening the exit. The blue video is beginning to understeer":

"Mid-corner to exit. I am still slower at this stage, but we are now both on the power. You can see part of the white line on my right, meaning I am closer to the inside edge of the track due to my later throttle application – allowing for a straighter exit":

"Almost at the exit. The driver in the blue video has now had to come off the throttle thanks to getting on the power too early and then understeering wide. You can see from the direction the front wheels are pointing that this sudden lift off has caused oversteer and a loss of speed. I have now matched the speed":

The blue-outlined video now has lift-off oversteer, the red does not.

"Exit. Because I have been patient mid corner, I have been able to stay on the power all the way through to the exit. This has resulted in my catching up and passing in terms of speed, and gaining valuable time on the corner exit until the next corner."

One tip that Ben has will allow you to study your throttle application in slightly finer detail, without having to connect to the throttle position sensor:

"I often put the **VIDEO VBOX** microphone in the engine bay – it picks up the change in engine note really well - and although it's not data that you can see in the graphs, by playing the videos separately it is entirely possible to demonstrate if one of my customers is early in picking up the power."

You can get more details about the coaching Ben Clucas provides on his website: http://www.benclucas.co.uk/

By using a **VBOX LAPTIMER**, it is possible to employ some of these techniques thanks to its unique Delta Velocity feature: two LEDs that change colour and intensity based on a comparison of your current speed against that of a reference lap.

The reference lap can be either the fastest one you've managed in the current session, or one you have previously loaded in – such as from an instructor.

Once you have set down a good reference lap, if you then brake a little too late into a corner, the LEDs light up bright green, giving you a heads up that you are carrying a bit too much speed. You may then have to hang on to the brakes for a bit longer in order to make the apex, in order not to lose too much speed on the exit.

Delta-T (time) shows you how much time a mistake has just cost, and Delta-V (speed) gives you warning that you are about to make a mistake.

Delta-V is also a constant reminder to exit the corner as quickly as possible, as you should be always trying to light the LEDs green on the exit of each corner. It is as though you have a virtual driving coach sat in the car alongside you!

Advanced Circuit Driving Techniques

Article 12: Spa Masterclass

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Advanced Circuit Driving Techniques

Article 12: Spa Masterclass

Spa presents a number of challenges to the racing driver, with its blend of fast and slow corners, big elevation changes, and a climate that is changeable at best. In this article we take a lap round the famous circuit with Nigel Greensall, at the wheel of an ex-works 1960 Austin Healey 3000.

The car is owned by Nigel's long term driving partners Karsten Le Blanc and Christiaen van Lanschot, and has an illustrious past, having competed three times at Le Mans in period. Prepared by Denis Welch Motorsport in the UK, it is the best known race Healey 3000 in the world.

This lap was done in qualifying at the Spa Six Hours – a big meeting in September that involves

a huge number of some of the best vintage race cars in Europe. The lap is particularly noteworthy because it was the first time that a vintage Healey went round Spa in under three minutes – and at the time of going to press the record still stands. Many of the techniques that Nigel employs throughout form the basis of several of our previous articles, along with some others that we have not discussed. Some of it is innate… in any case, it is truly a masterclass in racing technique.

As an accompanying resource to this article you can download the video and data files for replay in **Circuit Tools** from here: www.vboxmotorsport.co.uk/ebook/Spa_Masterclass.zip

Preparation

The two hour qualifying period is very nearly at an end when Nigel heads out. The session has been extremely busy with over a hundred cars vying for track position, making it impossible to get a clear track. However, just as it is coming to a conclusion a car has spilled oil at the top of the Kemmel Straight and as a consequence almost all the other competitors have called it a day – the perfect time to have a last gasp crack at pole position.

Nigel has just enough time to complete an out lap which allows him to assess the state of the track – and so armed he knows where the hazard lies (indeed, as he cruises round an E-Type goes off the track at Les Combes having hit the oil, and then parks up at Bruxelles), but that the circuit is virtually empty. This reconnaissance is very useful: with knowledge of the current situation, he knows he can drive to the car's limits during the last few minutes of qualifying.

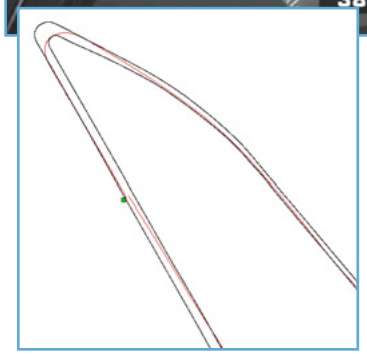
At the end of his out lap, before crossing the start/finish for the qualifying attempt, Nigel executes a Scandinavian flick through the Bus Stop chicane: "That's the fastest way through there in one of these cars. The induced oversteer allows you to rotate the car through the second apex giving an optimum exit speed and a slingshot onto the start/finish straight, gaining maximum possible velocity for the beginning of the lap." "Despite being later on the point of applying throttle, I get to full throttle sooner, so exit the corner faster, resulting in a further gain of 0.15 seconds:"

The Bus Stop Chicane requires a certain amount of deliberate oversteer to allow the car to be muscled through the corner.

Qualifying Lap

La Source

La Source, the first turn, is so sharp and short that Nigel takes the classic wide line on the approach and plants the right front wheel on the apex. A fast exit at La Source is absolutely key because it gives speed all the way down to the entry of Eau Rouge, so he doesn't employ the diagonal approach as he might at other slow, but longer, hairpin corners. (See Chapter Two: Slow Corners and Hairpins).



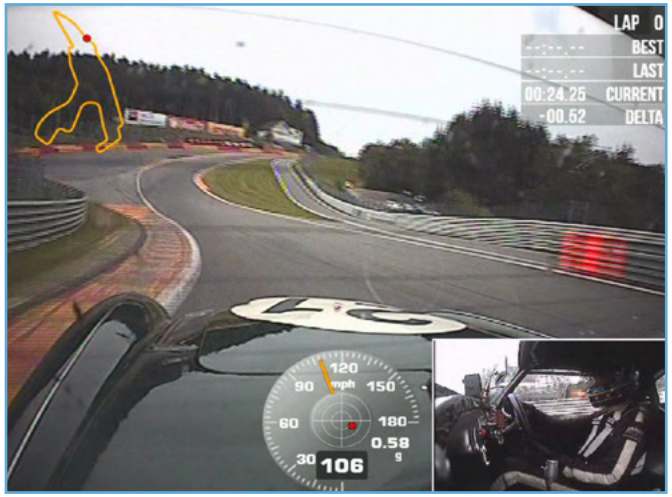
La Source is a short and sharp hairpin, so it is better to take a wide approach and concentrate on exit speed.

Eau Rouge and Raidillon

"Coming down towards Eau Rouge, I can see that I am going to have to get past the Alfa in front before the corner – if I don't, the lap is gone. This means compromising my usual entry: under normal circumstances I will go down the middle of the track before coming across towards the wall, then straightening up to take Eau Rouge, and subsequently Raidillon, as straight as possible." (See Chapter Four: How to Cut a Second on Eau Rouge).

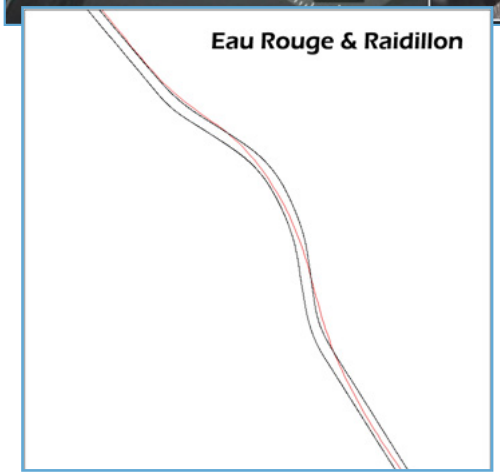
Getting past the slower moving Alfa Romeo on the approach to Eau Rouge is vital.

"So my entry into Eau Rouge is a bit slower than it would have been on a clear track. However, I can now maximise the exit speed."



Eau Rouge approach compromised due to traffic, but exit clear...

"Due to the compromised Eau Rouge entry, I arrive at Raidillon apex a little early. However with a bit of oversteer I am able to get the straight line exit, and so maintain momentum going up the Kemmel Straight."

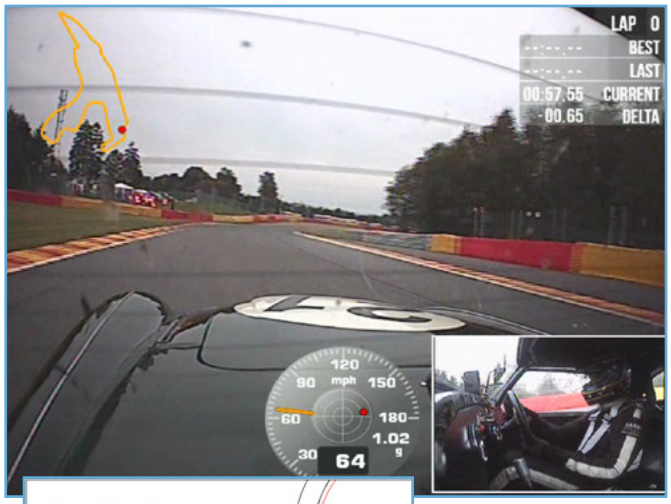


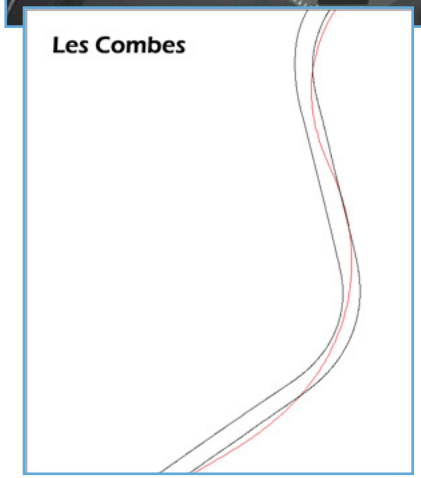
Les Combes

The next corner, Les Combes, is preceded by the oil spill at the end of the straight, necessitating a tighter line in and therefore a slightly slower entry speed.

This slower entry ensures that Nigel can hit the right and then left apexes of Les Combes. "It's very important not to go too wide after the left apex, which you see a lot of people doing. This is OK in something with a lot of downforce, say a Radical with slicks and wings and no weight, because it can manage those big changes in direction. But in a historic car like the Healey it doesn't have the dynamics that enable this, so after the middle apex at Les Combes I keep it as tight over to the left side of the track as I can, which allows me to build speed through the final right-hand apex."

Due to oil on the left side of the approach to Les Combes, a tighter line is required going into the corner.

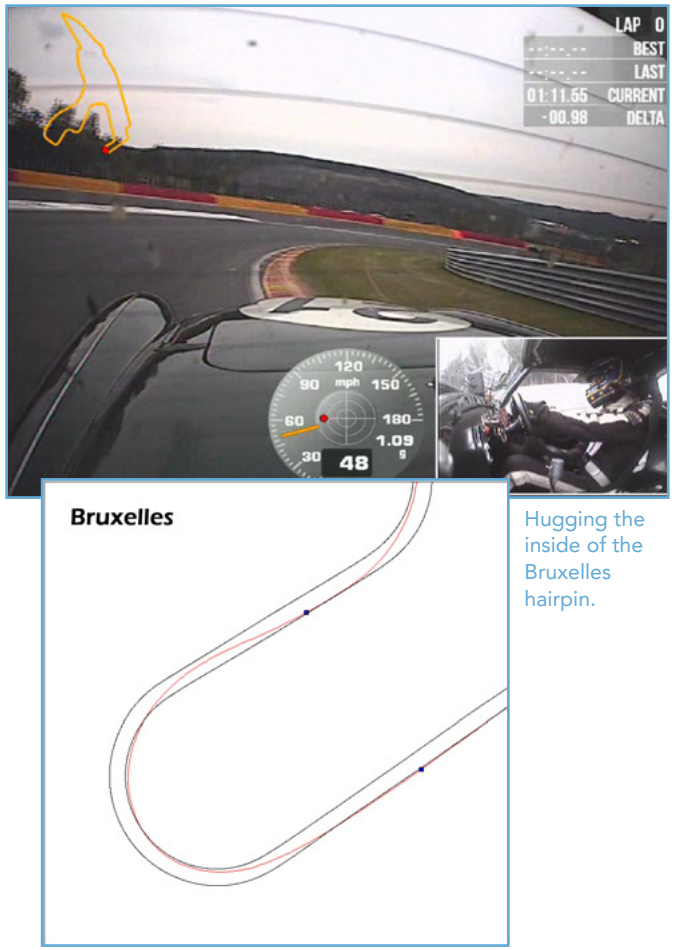




After the left at Les Combes, it is best to stay as much to left as possible rather than using the whole width of the track unless you're driving a car with lots of downforce.

Bruxelles

Next, the right-hand Bruxelles hairpin. Nigel shifts down to third, takes a diagonal approach towards the rumble strip, and hugs the inside of the corner all the way round.



Hugging the inside of the Bruxelles hairpin.

Pouhon

Full power down the small straight and with more empty road in front for the next left-hander, with a good apex and full width of the track on exit, Nigel is now 1.2s better than his last fastest lap. Time to take on Pouhon:

"Pouhon is wonderful – high speed, downhill, and off camber, it requires a delicate touch on the steering wheel. The car feels like it's falling away from the corner all the time. It's also two distinct corners (see Chapter One: Compound Corners) but it's taken more like one very long one. So I go for an early first apex, and a late second.

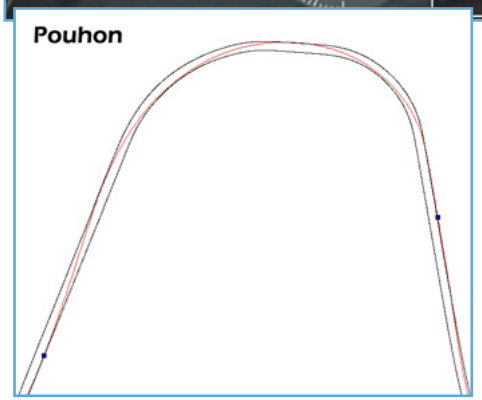
"The trick with historic cars at Pouhon is not to overbrake beforehand. When you turn in it needs to feel slightly too fast, and then slide the car a little to control the speed. So I turn in quite early, and drift it a little.

Pouhon first apex: don't mount the raised kerb.

"If you brake hard and late, you put all the weight on the front of the car and it will oversteer too much. So I brake lightly, and a little early – my braking marker is the start of the rumble strip on the right, just after the marshal's access road." (See Chapter 10 – Landmarking).

"Having turned in early creating a little oversteer I get very close to the first apex but don't hit the kerb, which is raised: coming into contact with it will push the car really wide. So I put the left front wheel on the white line, and then let the car go right out to the other side on the exit, but without crossing the rumble strip."

Approaching the second half of Pouhon, Nigel settles the car before turning for a late apex: "You're building speed all the way through this section – it's not quite flat out but you are always accelerating. The exit of the Pouhon corners also has a raised kerb but this time you can use it to your advantage – it's like a small section of positively-cambered banking. It's very helpful – but you mustn't run wide and over it because of the low-grip astro-turf on the outside."



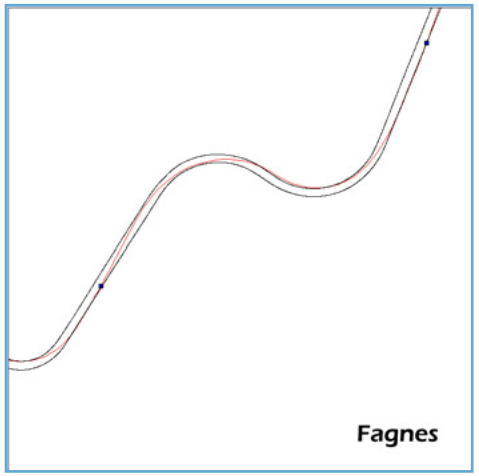
The Pouhon exit – use the raised kerb to your advantage as you build speed towards Fagnes.

Fagnes

The next significant landmark is the gantry as you approach the Esses (Fagnes). This is Nigel's turn-in point, which is very early – he starts from the left and aims diagonally at the apex which is about ten metres shorter than the classic wide approach.

A diagonal approach to the first apex at Fagnes is significantly shorter than the classic wide line.

This is then a long apex corner, hugging the inside line: "Here I play with the throttle, have the car sliding a little bit, and hang on to this long apex right until the very end of the red/yellow kerbing. This leaves me fully on the right hand side of the track and able to accelerate into the left hander."



Fagnes is a long apex and Nigel only changes direction towards the next left-hander at the very end of the kerbing

Coming off the apex at Fagnes, note here how Nigel is looking to the left into the next corner even before he has started to turn. Refer to Chapter Six – Vision and Cornering.

"However I momentarily lift off the throttle to get the car to turn left, and then power through the next apex. Avoid the kerbs on the exit – they are serrated and rough and can damage the car."

A momentary lift of the throttle puts the weight of the car on the front wheels and allows Nigel to get the car turned left for the second Fagnes corner.

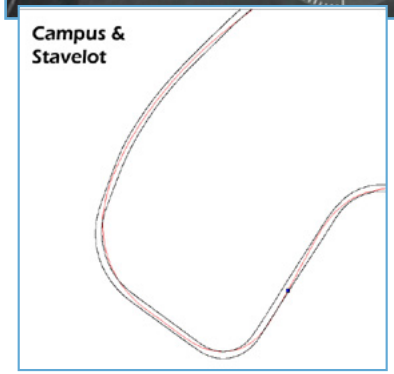
Campus

"Now we're coming down towards Campus and again the approach to this tight right-hander is downhill so you need to be careful that you don't arrive too fast - when you have finished your braking it feels like the car wants to gain momentum again. So make sure you slow it down and turn just before the end of the kerb on the left."

Careful braking on the approach to Campus, and turn-in just before the end of the kerb.

The focus at this point is how fast to get out of this corner – it is crucial because it dictates your speed all the way through Courbe Paul Frère and Blanchimont, right up to the Bus Stop.

"Campus is downhill and off camber, and often makes cars understeer which can radically affect the exit speed. So this is a classic 'slow in, fast out' corner – you have to be patient, hit the apex and get it straight as early as possible so that you can accelerate into the next, very fast, section of track. Fortunately the off-camber nature of the corner is slightly mitigated by another positive-camber kerb which you can use on the exit."



Another raised kerb, this time on the Campus exit, helps to offset the off-camber turn that can cause understeer and hence a slow exit speed.

Nigel stays on the kerb all the way along this short straight until the next turn-in:

Stavelot approach.

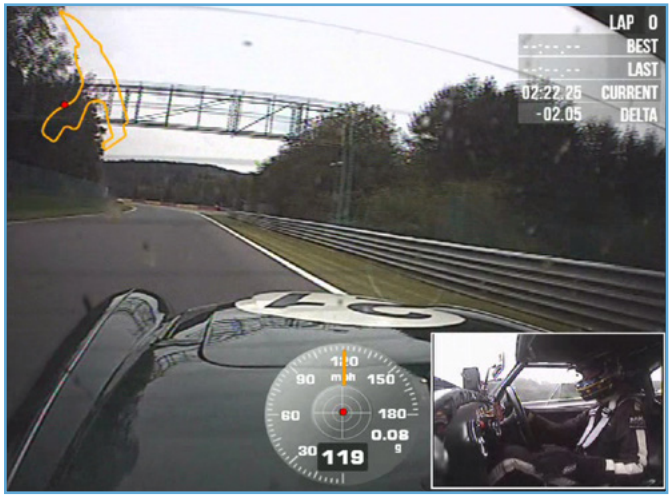
With the apex being at the very end of the red and yellow kerb:

Stavelot apex.

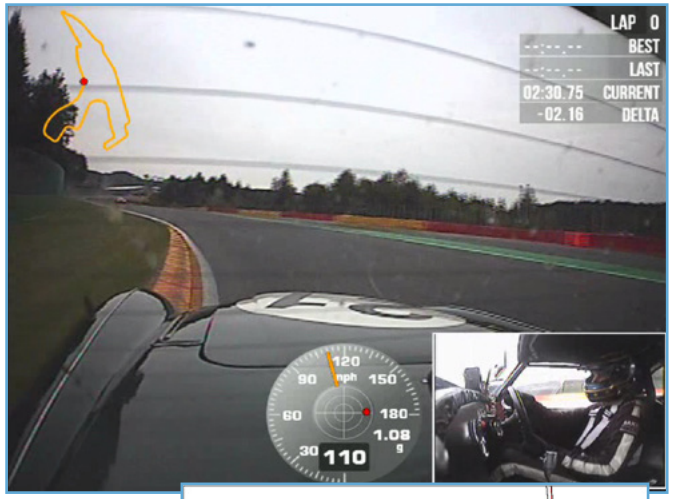
Blanchimont

"After Stavelot, I want to take the shortest possible line through the long right-hander, then look out for the next landmark prior to the slight left before Blanchimont – once more I use the gantry. Again, you want this to be straight as you can get it, so turn at the gantry, get to the drain, and then let it go right back out."

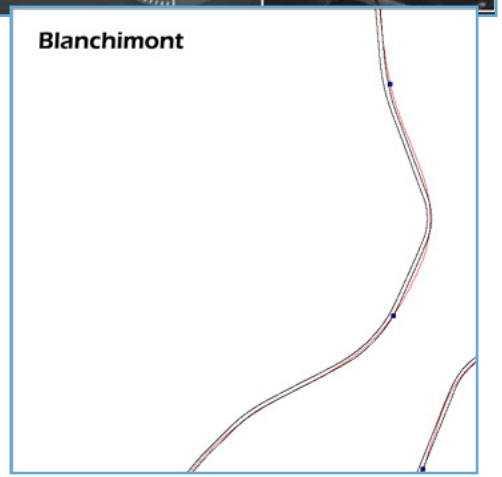
"It is important to accelerate through Blanchimont – straighten it out as much as you can, but don't arrive too fast at it and have to slow down through it. Avoid the kerb on the inside – it's another one that will push you wide."



Turn point for Blanchimont at the gantry.



Blanchimont apex – avoid the kerb.

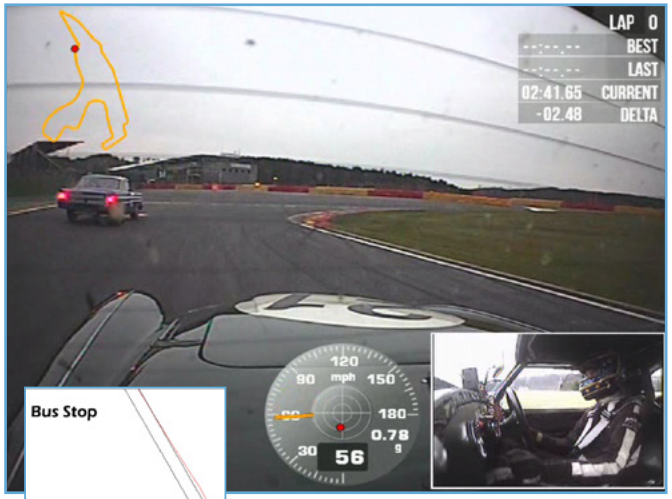


On the exit of Blanchimont, go in a straight line until the 150m marker board. "A lot of drivers will go to the left here, but it's a lot further to go."

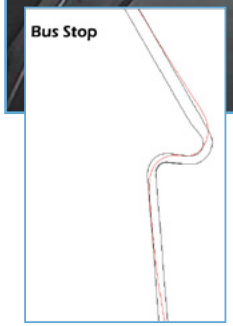
Chicane

"On the approach to the Bus Stop chicane I arrive to find a Ford Falcon that looks like it has finished for the day and is on a slowing down lap, possibly heading for the pits… having managed to get to this point two and a half seconds quicker than my previous best lap it would be a shame to lose it all on the penultimate corner.

"Fortunately the driver is very observant and gives me the space to make the apex. I show my appreciation with a wave of thanks as I slide through the Bus Stop chicane."



Nigel appreciates the awareness of the Ford Falcon driver in front.



Nigel flicks the car through the Bus Stop again: "That's the fastest way to get one of these things through there" and hammers it down the start/finish.

Lap time: 2:56.94.

A lot of what Nigel does in this lap comes from many years of honed practice and experience: but some of the techniques we've described here are perfectly achievable for the amateur driver. If you are about to drive this famous circuit for the first time, you can put yourself at an advantage by studying the video and data that accompanies this article. As Mr Greensall himself would say: "Remember to always drive with precision."

Advanced Circuit Driving Techniques

Article 13: Making mistakes gives you speed

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Advanced Circuit Driving Techniques

Article 13: Making mistakes gives you speed

How can you improve if you don't have anyone to compare against? This is a question I have been asked a number of times by our customers. I answer it by giving some examples of how I go about finding lap time when I am driving solo.

Given plentiful testing and ideal conditions, you can begin to experiment with lines and techniques to find out what changes you can make to gain lap time. However, in the real world our track time is constrained and often compromised by other cars, so you may not have the opportunity to experiment and try something different.

I was in this exact situation recently at Zandvoort race track whilst racing my Jaguar E Type. The Zandvoort Historic Grand Prix is a fabulous event, held on one of the best and most exhilarating tracks in Europe. However, there is no testing for this event, you go straight into a 40 minute qualifying session for the race the next day. To compound matters, at the start of qualifying, my ignition barrel decided to rattle loose, costing me precious track time, and I ended up with just 23 minutes to set a lap time.

In this situation I had no time to try different lines and just concentrated on putting together a clean lap. I managed to qualify 6th on the grid, but I knew that the car should be capable of a top three finish, so I had some work to do before the race.

I took the data and video from my **VBOX** back to the hotel and in about 20 minutes I had worked out how to go a second a lap quicker. How did I do this?

Well, the good thing is that I made a number of mistakes, and I also had quite a bit of traffic. That sounds counter-intuitive, but it meant that I often drove a different line through a number of corners compared with what I was thought was the ideal line.

On loading the data I could see that my fastest lap was 2m 0.66s. Circuit Tools automatically splits the track up into sectors: in the case of Zandvoort, it created 8 sectors in total. To make it easier to spot the best sectors of a session, the quickest times are colour coded purple, and these are the juicy bits from which you can gain some insights on how to improve.

So how do you go about finding that time?

Looking at the lap data from that session, on my fastest (lap 7) I had only set two 'purple' sectors, which meant that there were 6 sectors where I had driven quicker on other laps, sectors 1, 4, 5, 6, 7, & 8. Plenty of room for improvement there!

+VBOX0005

Show		Lap	Time	Delta	VMax	Datum	S1	S2	S3	S4	S5	S6	S7	S8
☐		1	02:03.16	+02.49	215.730	☐	+00.58	+00.52	+00.28	+00.35	+00.18	+00.32	-00.22	+00.46
☐		2	02:07.70	+07.03	220.658	☐	+00.68	+02.10	+01.05	+00.46	+00.02	+00.06	+01.14	+01.50
☐		3	02:10.70	+10.03	204.408	☐	+03.04	+03.74	+01.74	+00.36	-00.09	-00.18	+00.65	+00.74
☐		4	02:01.40	+00.73	220.705	☐	-00.04	+00.11	+00.21	+00.38	-00.23	-00.11	+00.06	+00.33
☐		5	02:03.42	+02.76	222.617	☐	+00.14	+00.84	+00.21	+00.02	-00.17	+00.73	+00.35	+00.61
☑		6	02:01.48	+00.81	222.426	☐	-00.17	+00.28	+00.08	+00.06	+00.20	+00.59	-00.36	+00.11
☑		7	**02:00.66**	**00.00**	**221.360**	☑	**17.29**	**23.60**	**11.60**	**07.70**	**08.50**	**15.10**	**16.90**	**19.97**
☐		8	02:01.73	+01.06	224.222	☐	+00.30	+00.21	+00.17	+00.21	-00.07	-00.00	-00.02	+00.26
☐		9	02:01.49	+00.82	221.040	☐	+00.08	+00.55	+00.17	-00.00	+00.00	+00.20	-00.16	-00.03
☐		10	23:14.24	+21:13.58	208.094	☐	+02.70	+09.98	+08.38	+04.17	+02.15	+05.22	+08.52	-

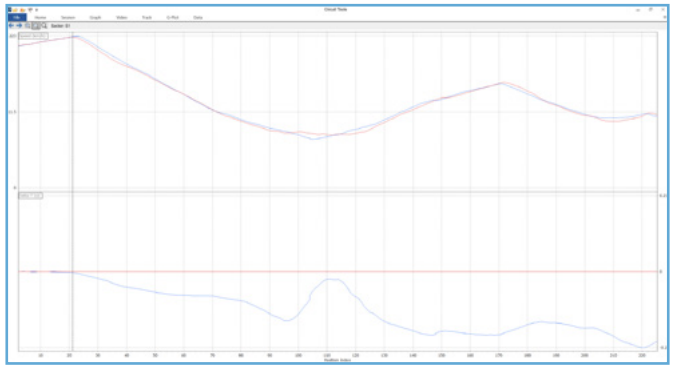
Sector times for qualifying session with fastest shown in purple.

Looking at Sector 1, I gained 0.17s the previous lap, so this is a good place to start.

Sector 1 covers the main start/finish straight and Turn 1, Tarzan:

Comparing the two laps it isn't immediately obvious where the time had come from, but from the speed traces it looks like I had braked a bit later on the previous lap:

Pressing F9 shows this graph in more detail:



The blue speed trace is the lap before, the red speed trace is my fastest lap, and the blue line on the bottom is the Delta-t channel showing time lost or gained.

This information is not enough to enable me to reliably gain this extra time, because as a driver, to be told to 'brake later' is too vague…!

Now the reason my braking points varied throughout qualifying was because at 135-140mph it was difficult to spot any decent reference points on the side of the track, so I was making small mistakes each lap. Now back in the hotel, with the video and data in front of me I could work out much more precisely where I should be braking.

By pressing F5, we can get full screen video and if we stop the video from my fastest lap at the point where I hit the brakes, the reference point is the concrete viewing platform on the left hand side:

However, if we do the same for the previous lap, we can get a new reference point for my braking:

In this case, the better braking point is at the first speaker after the concrete platform (this is a perfect example of finding your landmarks – see chapter 10).

After replaying the video a few times, I practised waiting until this point to start braking.

So that was 0.17s in the bag, where next to gain some time?

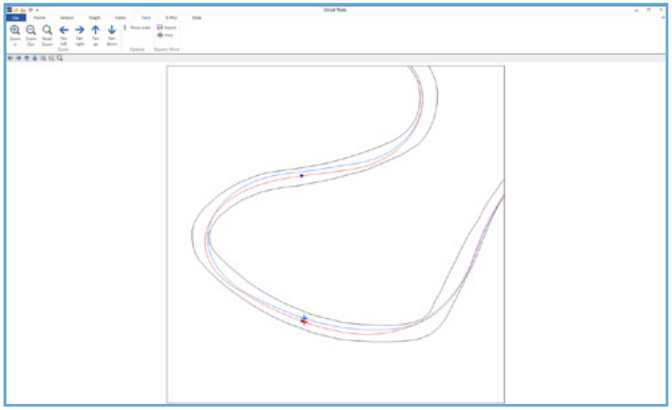
The next sector where I set a purple on a different lap was Sector 5 on lap 4:

This is a particularly tricky section as there are a number of corners which all run into each other, and the track is very wide and featureless just here. Consequently, there are a large number of different lines you can take, and it takes a number of laps before you stop feeling a bit lost through this part of the track.

By selecting lap 4 as the comparison and moving the cursor to Sector 5, we can go looking for the time gained:

Again, the red speed trace is my fastest lap, and the blue speed trace is the lap where I went quicker through this section. I gain nicely through this whole section, but there is not a large difference in speeds, so what is going on?

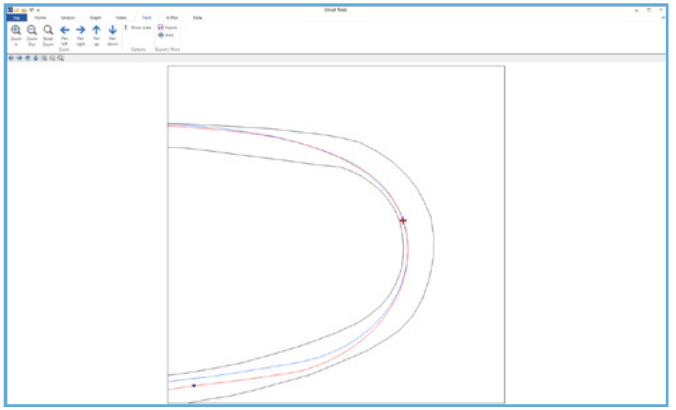
If we compare the lines through these corners by pressing F11, the answer becomes a bit more obvious:



I took two very different lines on these two laps, with the blue line generating the better sector time. The reason the blue line is quicker is due to the shorter distance travelled between the three apexes. Whilst the speed may be a little lower on this tighter line, the fact that I covered 10m less was worth 0.3s, and it was worth sacrificing a little bit of speed to hold a tighter line.

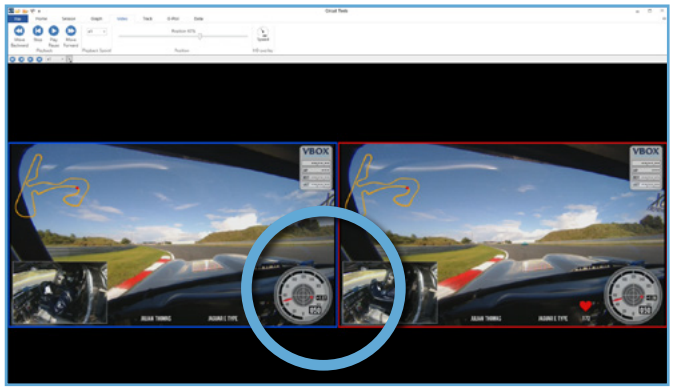
Looking at the exit of this section (in the top of the picture), you may think that I have compromised my entry into the hairpin. Surely taking a wider line into the hairpin would mean a faster exit?

This would certainly be true if I could hold a wider radius by taking this line, but on a very tight hairpin, the minimum radius can be the same on a number of different lines:



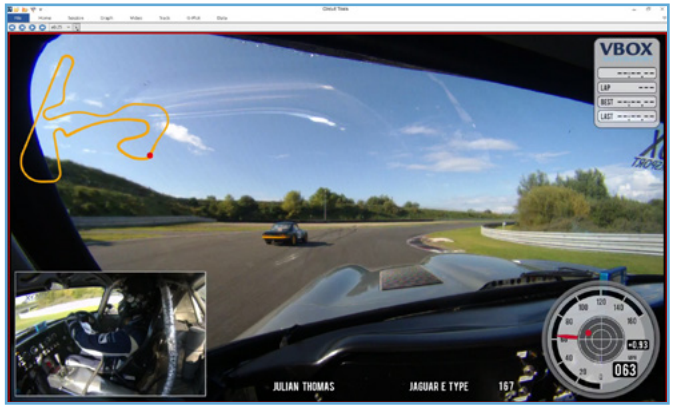
The minimum radius dictates the minimum speed, so there is no advantage in exit speed by taking the line in red.

You can clearly see this in the side by side video if it is paused at the apex of this hairpin:



Comparing apex speeds for two different lines around the hairpin – identical!

Now what made me take this narrower line? I would like to say that it was me experimenting with the track, but looking at the video, it was in reality caused by traffic forcing me to take the tighter line in both corners:



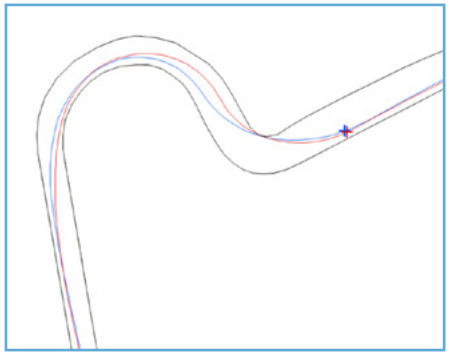
So the good news from being 'baulked' in qualifying was that I found another 0.3s that I could use during the race!

Finally, the largest gain was from Sector 7, where I went 0.36s fastest on the previous lap:

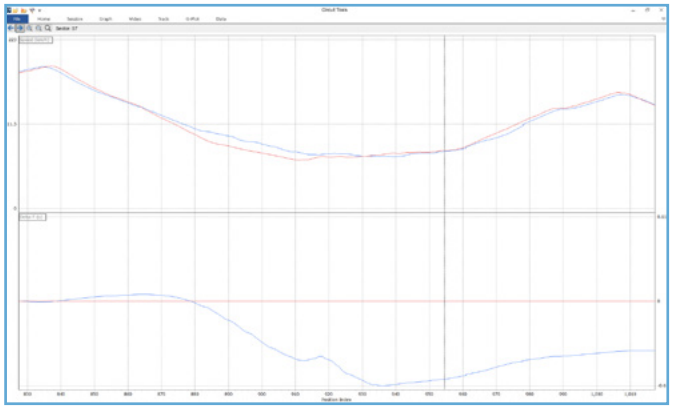
0.36s gained through this section on previous lap

This is tricky section because there is long straight, with heavy braking, before entering a tight right/ left hander:

Getting your braking point right for this section is crucial, and on the previous lap, I appeared to brake a little bit late and went deeper into the first corner than I would have liked:



However, yet again, this mistake meant that I was actually quicker through this section because I carried more speed in, and this line was also a bit shorter (by 3.5m). In this case I did compromise my exit speed, but the straight afterwards was not long enough to regain the time I had already lost by going in slower on the wider line:



Faster entry worth 0.61s, faster exit only worth 0.25s, because faster entry is also shorter by 3.5m

Conclusion

By analysing how I achieved my fastest sectors, I could, in theory, string together a lap which was 1s a lap faster:

Sector 1 +0.17

Sector 2 +0.00

Sector 3 +0.00

Sector 4 +0.00

Sector 5 +0.23

Sector 6 +0.18

Sector 7 +0.36

Sector 8 +0.03

Potential gain 0.99s

This would have been good enough for P3 in qualifying, and it meant that I went into the race knowing where I could gain some easy lap time.

As an accompanying resource to this chapter, the video and data files are available to download from the **VBOX MOTORSPORT** website so that you can carry out exactly the same analysis in the **CIRCUIT TOOLS** software.

Download **CIRCUIT TOOLS** from here:
www.vboxmotorsport.co.uk/index.php/en/customer-area/software

Download the example files from here:
www.vboxmotorsport.co.uk/ebook/zandvoort_data.zip

Advanced Circuit Driving Techniques

Article 14: Mastering Corner Entry

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Article 14: Mastering Corner Entry

Julian Thomas examines the various elements of approaching and entering a corner. This chapter is made up of videos.

Part 1 Positioning and Braking:

https://www.youtube.com/watch?v=blm8KcCqlOE&t=48s

Part 2 Tyre Friction Circle and Balance:

https://www.youtube.com/watch?v=p9FuaRCNbpk&t=40s

Part 3 Where and How to Improve:

https://www.youtube.com/watch?v=r63Ba9aUwGA&t=30s

Advanced Circuit Driving Techniques

Article 15:

The science of rapid race car optimisation using tyre temperature

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Advanced Circuit Driving Techniques

Article 15: The science of rapid race car optimisation using tyre temperature

Maximising the contact patch is the best way to get the most out of your tyre and ultimately improve lap times. There are many variables which affect how your rubber is interacting with the track surface, such as camber, caster, toe-in, brake bias and tyre pressure. There are so many ways of changing the handing characteristics of a race car, so how can you go about this in a scientific way?

One answer is to use the wealth of information that the latest generation of tyre temperature sensors can give you. They read 16 independent values across the width of a tyre, allowing you to see exactly how hard your tyre is being worked, across its whole surface.

One of the **VBOX** Tyre Temperature Monitoring Sensors

https://www.vboxmotorsport.co.uk/index.php/en/products/accessories/tyre-temperature-monitoring-system

Optimising Camber

Under load, you want as much of the rubber contacting the track as possible. This normally means running negative camber so that when the car rolls during cornering, the tyre is as flat as possible in respect to the surface of the track. Therefore, during steady state cornering, the temperature across the tyre should be as uniform as possible.

Note that when you take a manual reading in the pits, you can only get an average overview of the temperature profile, so you can easily misinterpret the data, as tyres rapidly lose surface temperature in a straight line. Also, any negative camber will keep the inside of the tyre warmer than the outside, skewing the data.

In this example, I was driving a Chevron B8, and it had significant understeer on the exits of most corners. Taking a manual reading across the tyres throughout the season didn't indicate any particular camber problems.

We then fitted some tyre temperature sensors, and quickly saw that the front tyres were getting hot on the inside of the tyre, but only during the exit phase of the corner. You can see this in the tyre temperature graphic in the top right hand corner. The front left tyre is showing a marked temperature difference across the tyre of 23°C.

Front left tyre showing steep temperature gradient of 23°C

By reducing the front camber, the temperature gradient became a lot less pronounced, and the grip at the front of the car was significantly more consistent and the understeer was significantly reduced. This gave us a benefit of 1.2s a lap around the Silverstone GP circuit:

After camber-change, front left showing temp gradient of only 9°C

As you can see in the second screenshot, there is still a small temperature difference of 9°C, so this tells us that the camber can still be reduced very slightly to get the temperature even across the tyre.

Normally, you wouldn't be able to adjust the camber to such a fine degree and feel any difference in the handling or spot a definitive improvement in lap time, as you would have to make a much bigger change. However, by using the instantaneous temperature gradient during cornering, you can fine tune the camber with confidence, knowing that you are getting as close as possible to the optimum value, which wouldn't normally be possible using traditional methods.

The benefit of this camber reduction wasn't only in helping the understeer, but it also gave better grip under braking as more of the tyre was in contact with the track, and less tyre wear on the inside of the tyre.

Optimising brake bias

To get the most out of your braking system, it is vital to fine tune the brake bias so you have an even distribution of load between the front and rear tyres. This is a tricky process to carry out and requires a degree of experience and understanding on the behalf of the driver. Even with the very best drivers, this is very much a trial and error process.

The more force you put through a tyre, the hotter it becomes. Therefore, you can see how hard the front tyres are working in relation to the rear by looking at their temperature during the braking phase.

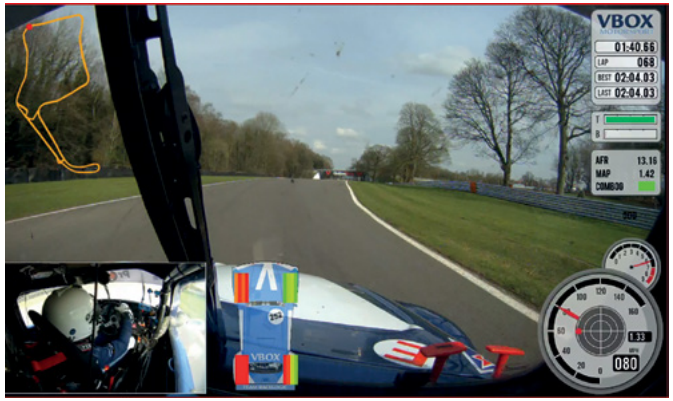
Here is a good example where I was driving a Cobra Daytona at Spa, and braking down from 155 mph to 55mph at the end of the Kemmel Straight:

Too much rear bias leads to cold front tyres during turn in

You can see from this snapshot that the rear tyres have warmed up more than the front during the braking phase. This indicates that the bias is set slightly too much to the rear. By moving the brake bias forward, the braking performance could be improved.

Not only that, but by putting more energy into the front tyres, they would warmer before the crucial corner entry phase. In fact, with too much rear bias, the front tyres were cooling down on the long Kemmel straight and not coming up to temperature until the exit of the corner. Without this data, you wouldn't think that you can reduce corner entry understeer by moving the brake bias forward..!

On a different car, we have also seen too much rear bias overheating the rear tyres on the entry into a fast corner, which then leads to oversteer later on in the corner as the rear tyres have become too hot:



Too much rear bias overheats the rear tyres, causing late corner oversteer

Optimising tyre pressures

The best tyre pressure is one that enables an even contact patch for the rubber on the track surface. Too much pressure makes the tyre balloon and too little makes it collapse in the middle.

By using tyre temperatures, you can see this happening in real-time. If the centre of the tyre is colder than the rest, then the pressure is too low, and if the centre of the tyre is hotter, then the pressure is too high.

In the following example, the front right tyre is showing signs that it is over-inflated, you can see the hottest part of the tyre is in the middle:

This allows you to finely tune the pressure of each tyre

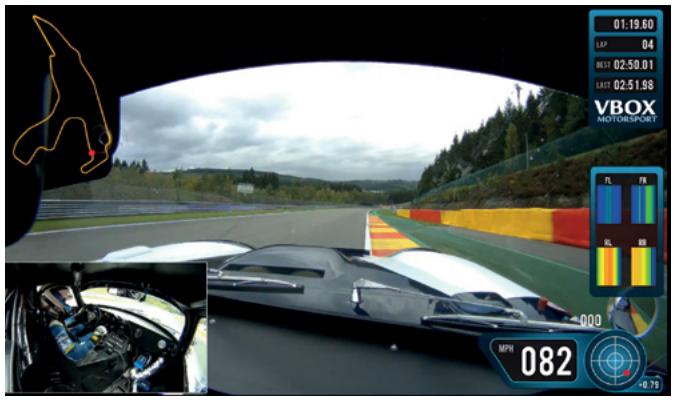
Front right tyre hotter in the middle

to maintain the best possible contact patch. This then works the tyre more evenly, and the long term tyre wear will be reduced.

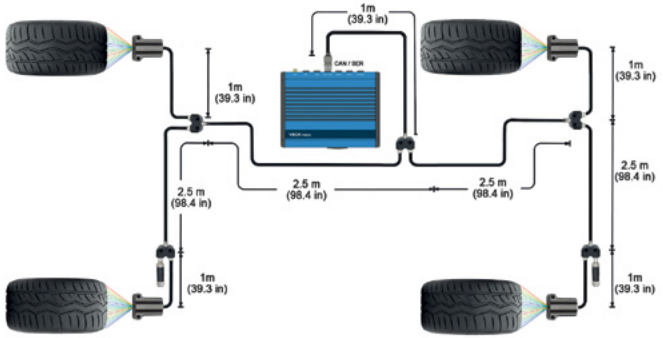
Here is another example, where the front right tyre is under-inflated and there is an obvious cold patch in the middle:

Front right tyre colder in the middle

Another example where the left rear is over-inflated:



Left rear tyre hotter in the middle



Conclusion

As you can see from some real world examples, real science can be applied to the process of optimising camber, brake bias and tyre pressures. Previously this would involve a lot more testing and is very dependent on the feedback from the driver, which can be difficult to determine in a short test session.

Live Streaming

If you want to speed the setup process up even further, then you can Live Stream this video back to the pits, so the engineers can see what is happening to each tyre, and be ready to make adjustments the moment the car comes back into the pits. In this way, the car's setup can be perfected with objective measurements in a very quick time frame.

Advanced Circuit Driving Techniques

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Article 16: The Art of Slipstreaming

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Advanced Circuit Driving Techniques

Article 16: The Art of Slipstreaming

Ben Clucas is a professional racing driver and coach, former works Toyota, Jaguar, and KIA factory driver with 3 decades of racing experience in a variety of different cars across 4 continents. In this chapter Ben takes us through the art of slipstreaming and how to maximise the potential gains.

Slipstreaming can be very important, especially in one make racing, or in cars that are not very aerodynamic. It can make a significant difference both to qualifying, or trying to get that final lap overtake done, but it is not just a case of sitting behind the other car and hoping for the best. You also get a benefit from the car in front from quite a long way behind as you can see from the below data:

The data shown bottom left is from the same session just 2 laps apart. The video on the right gains 0.25 seconds down one straight alone at Silverstone, despite being around 7-10 car lengths behind the car in front. This makes 3 miles an hour difference by the end of straight as you can see from the data clip below. If you can get this down every straight at Silverstone on one lap this can be worth between 1.5-2 seconds per lap.

Naturally the closer you are the more of a slipstream you get (within reason), you will also go even faster down the straight if the car in front of you also has a slipstream, as shown by the clips below. Again, both clips are from the same session, and in both I have a slipstream, but because I am closer to the car in front in the video on the right I go 3 miles an hour faster and gain just over 0.2 seconds by the end of the straight.

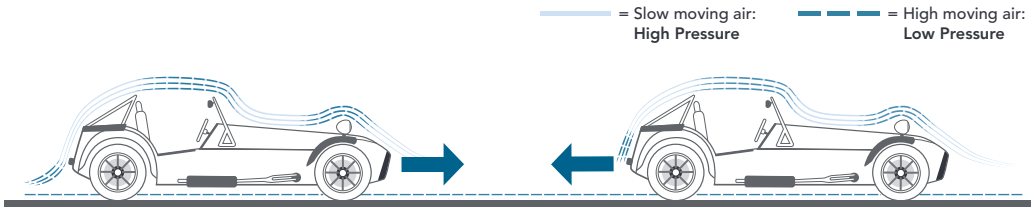
This may sound strange but going faster down the straight is not the only consideration when trying to judge slipstream, especially in a qualifying session. I gain 0.2 seconds in the video on the right down the straight, but as I am so close going into the next corner I can't then take the corner as fast as I normally would and end up losing 0.15 seconds because of this.

There is not really a right answer to how much of a gap you should leave when trying to get a slipstream in qualifying. It depends on several factors that all have an influence on your decision.

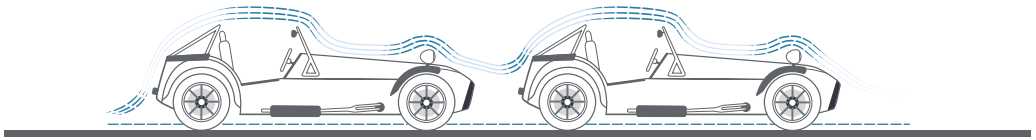
The circuit is one and how easy it is to overtake without losing time. Naturally a wider circuit such as Silverstone is much easier to get passed people than Cadwell for example, so you can stay closer to people at Silverstone, get more of a slipstream and then hope to overtake them losing minimal time.

Some cars will get more of a slipstream than others. The less of a slipstream the car gets, the closer you will need to be to the car in front.

Both you and your competitors' experience level has a huge impact on how close you can stay to the cars in front without losing time. If you are inexperienced, you will naturally feel less comfortable attacking corners while close to the car in front. You can quite often negate all the time you've gained in the slipstream down the straight by being too cautious in the next corner when you are closer to the car in front. If your competitors are less experienced, they are more likely to make a mistake when you are close to them, again undoing any straight-line speed advantage and time gained you've had by being in their slipstream.



Low pressure between the cars pulls the trailing car forward



Both cars go faster

A slipstream done correctly in certain cars can gain you up to 2 seconds a lap, and can be the difference between being on pole or outside the top 10 at the end of that vital qualifying session.

Knowing exactly how much of a gap to leave is almost impossible to judge, and has some degree of luck involved, but you can give yourself more chance of getting it right and increase your chances of getting that one lap where everything falls into place.

If you're inexperienced and on a narrow circuit that is harder to overtake on, then leave a bigger gap. In certain cars you will still gain a surprising amount of time from 10-15 car lengths back compared to a normal lap without a tow. This will give you the confidence to still take the corners as fast as you can while gaining a bit from the cars ahead.

If you're confident at overtaking, and comfortable driving close to other cars while still attacking the corner entries, then leave a smaller gap and be prepared to overtake cars during the lap. This will gain you the most time, but also gives you the biggest chance of having your lap spoiled through no fault of your own.

Whichever method you choose always remember qualifying is normally only about one lap, so if the previous lap has been ruined (which you can always tell from your VBOX predictive lap timing display) back off and prepare for the next lap by getting the gap to the cars in front correct well in advance.

The last thing you want to be doing is backing off over the start/finish line ruining 2 laps, especially as on some long circuits you may only get 6 or 7 laps during the session.

Advanced Circuit Driving Techniques

VBOX MOTORSPORT

VBOX VIDEO HD2
two cameras and High Definition video capture

VIDEO VBOX PRO
with two cameras and predictive lap timing display

VIDEO VBOX LITE
with two cameras and predictive lap timing display

All the video and data in these articles were recorded using a **VBOX MOTORSPORT VIDEO DATA LOGGER** as pictured above. The screenshots have been taken from **CIRCUIT TOOLS**, intuitive analysis software that comes included with every **VBOX MOTORSPORT** product.

VBOX VIDEO HD2 and the **VIDEO VBOX** range incorporate a GPS engine and synchronised video recorder with customisable graphic overlay, designed and manufactured in the UK by ***RACELOGIC***.

Anyone can work through the examples in these chapters using **CIRCUIT TOOLS** and the files available that accompany them. Download the software from the **VBOX MOTORSPORT** website: https://www.vboxmotorsport.co.uk

A lot more information about ***RACELOGIC'S*** motorsport products and where to buy them is available from https://www.vboxmotorsport.co.uk

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