

Race Engineering Data Analysis

by Josh William Youngs

FILE	4769_JOSH_WILLIAM_YOUNGS_RACE_ENGINEERING_DATA_ANALYSIS_138915_954629567.DOCX		
TIME SUBMITTED	17-DEC-2018 05:49AM (UTC+0000)	WORD COUNT	2278
SUBMISSION ID	97558435	CHARACTER COUNT	12854

University of Wales Trinity Saint David

School of Engineering

Driver comparison through data analysis



PRIFYSGOL CYMRU

Y Drindod Dewi Sant

UNIVERSITY OF WALES

Trinity Saint David

Written by: Josh William Youngs

Student Number: P146500

BSc Motorsport & Automotive Engineering

December 2018

Race Engineering (M6X02207)

Contents

1.0 Report Subject.....	4
1.1 Test Parameters	4
2.0 Individual Driver Analysis	5
2.1 Session 1 Driver A.....	5
.....	6
2.2 Session 1 Driver B.....	7
2.3 Session 1 Driver C.....	8
2.4 Driver Comparison Session 1	9
3.0 Test Session 2.....	11
3.1 Driver A Improvements.....	11
3.2 Driver B Improvements	12
3.4 Driver C Improvements.....	13
4.0 Conclusion.....	14
5.0 Bibliography	15

Introduction

Within this report, 2 simulator testing session will be analysed with the aid of Data Analysis software. By comparing 3 drivers, improvements are hoped to be made to each driver. Throttle application and Braking will be reviewed in order to gain perspective on possible improvements for each driver.

1.0 Report Subject

Within this report an analysis of 2 Motorsport simulation test sessions will be carried out. These sessions have been conducted in order to dissect driver techniques and vehicle optimization using data gathered within a Simulator.

Within this test 3 drivers of varying experience will undertake planned test session in the simulator. Within session 1 each driver will individually take to the track and drive for an exact amount of time. This time will allow for the driver to learn the track and put together some laps in which they can test their ability.

Session 2 will follow after the dissection of data from the first outing. Using data analysis software (Motec), each drivers style and technique will be pitted against each other. This is so that the fastest lines and driver technique can be applied to improve each driver.

1.1 Test Parameters

Each test session must've been no longer than 2 hours long, with each driver having put together fast laps. The track and vehicle used were variables that were chosen to suit the report.

Car Choice – Aston Martin DBR9 GT1. This vehicle was chosen as it uses downforce as an integral part of its operation. This will prove more applicable to future testing as vehicle setup changes are made. But the fact this vehicle uses downforce means that the driver must make best use of the track to optimize the vehicle setup.

Track choice – Brands Hatch (Full GP). This track was chosen as it has many varying corners from slow turns after heavy braking, to high speed corners. This track is also a good length (3.9km) for the test as each lap time was an average of 1 minute 26 seconds. This in theory would have given each driver ample time to acclimatize to the track and put together some best times.

Driver Choice – When selecting the drivers, it was decided that a base driver would be needed. This base driver would need to be someone whom is very experienced within the cockpit in the simulator. Tim Tudor the driver for the UWTSD MCR team was chosen, as he has real world experience of the track, as well as many hours within the simulator. The brief required 3 drivers to be selected, this meant 2 more drivers other than the base driver needed to be selected. Within respect to keeping the test procedure consistent, 2 more drivers of similar height were chosen. This would mean the pedals within the simulator would not need to be changed, thus each driver keeping the same driving position. The drivers were as follows

Driver A – Tim Tudor. Holder of a Race licence, real world experience of the track and many hours within the simulator.

Driver B – Josh Youngs. Very experienced within the simulator having been apart of tests on the same track in separate testing sessions.

Driver C – Daniel Salathiel. Zero amount of experience within the simulator although familiar to the layout of the track.

These drivers of varying experience and skills levels were ideal to analyse difference in technique and track approach.

2.0 Individual Driver Analysis

2.1 Session 1 Driver A

With the use of “**Data Power : using racecar data acquisition**” – Fey 1993, analysis of each drivers technique can be comprehended. By using the data trace gathered by the simulator, and then implemented into Motec, exact input can be measured. Inputs such as :

- Throttle Application
- Steering Angle
- Brake Application
- Gear Changing
- Corner Speed

With the aid of these elements each drivers lap can be digested to break down the components in which make them fast or slow.

Figure 1 Analysis of Driver A's Throttle trace : Driver A shows smooth throttle application with the exception to Turns 2,5 and 8.

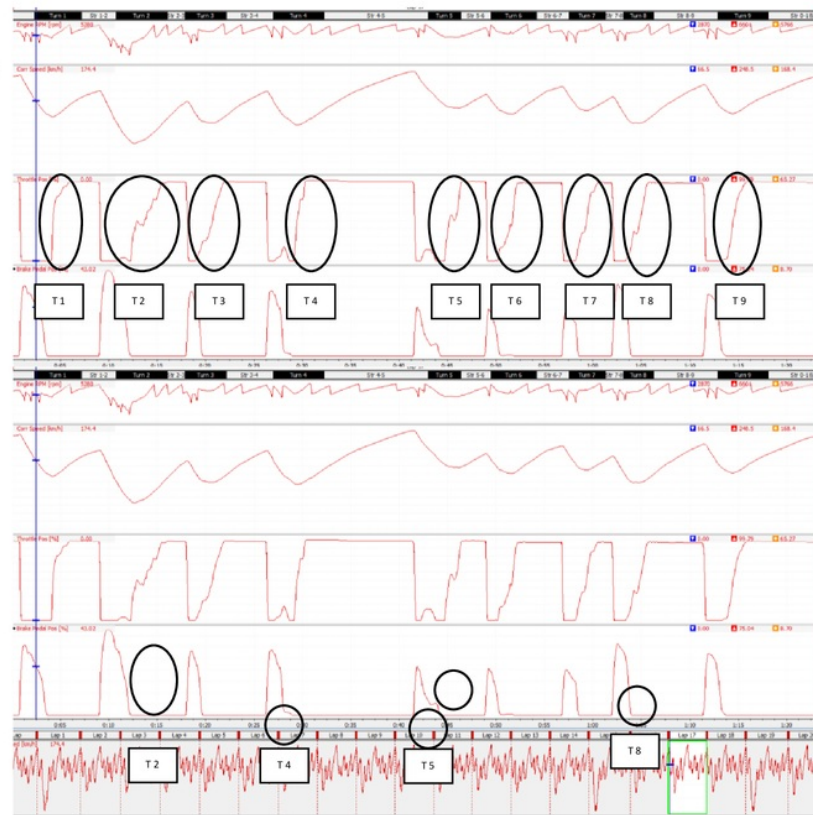


Figure 2 Throttle Correction or Hesitation Shown by

Driver A

Figure 1 displays how smoothly Driver A applies the throttle. With few example of hesitation or correction Driver A is able to apply the throttle affectively. This is a sign knowing when to apply during a corner. Although it can be seen in **Figure 2** that during turns 2,4,5 and 8 some correction/hesitation is present

Figure 3: Driver A's Braking Trace Percentages

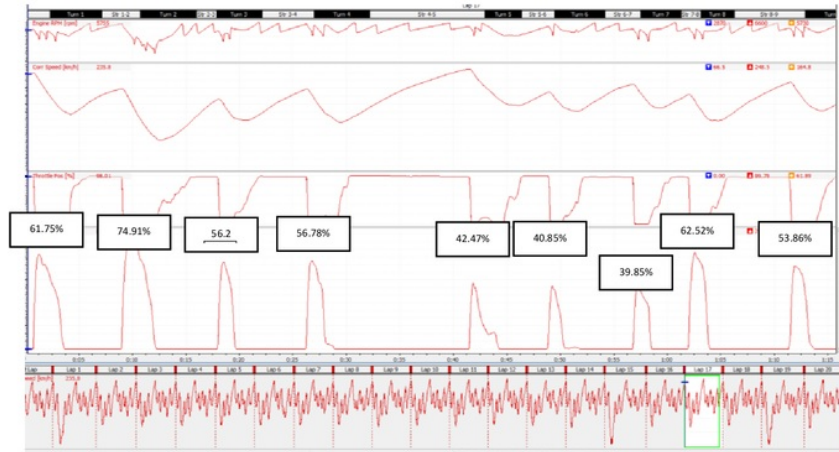


Figure 4: Driver A's Braking Technique

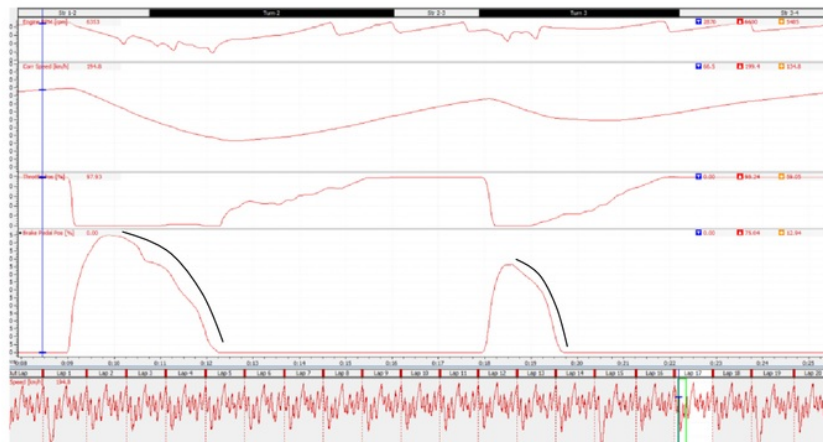
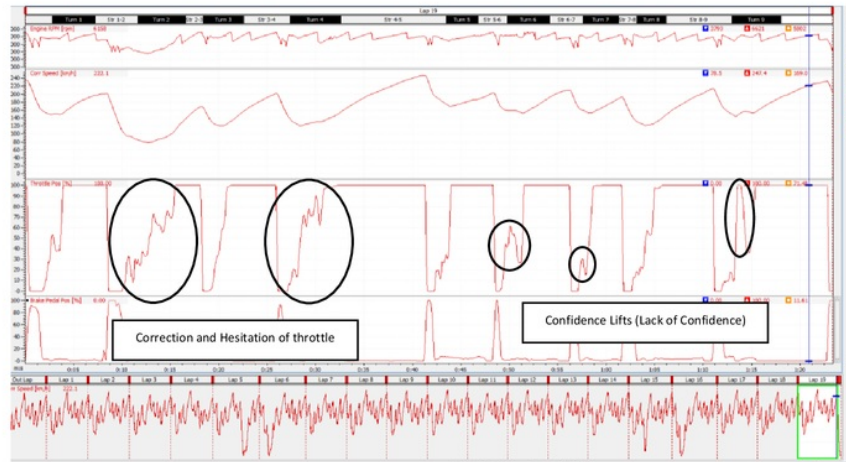


Figure 3 shows that Driver A's maximum braking force around the track is 74.91%. In terms of using most of the brakes available, Driver A isn't using the brakes to their full potential braking force. Although **Figure 4** clearly portrays Driver A's braking technique. As the driver is coming to the end of the braking phase, they're slowly coming off the pedal. This will in terms allow the wheels to start turning freely, and stabilize the vehicle ready for acceleration. This technique shows Driver A is experienced, as "Trail braking" is a skill widely used within motorsports.

2.2 Session 1 Driver B

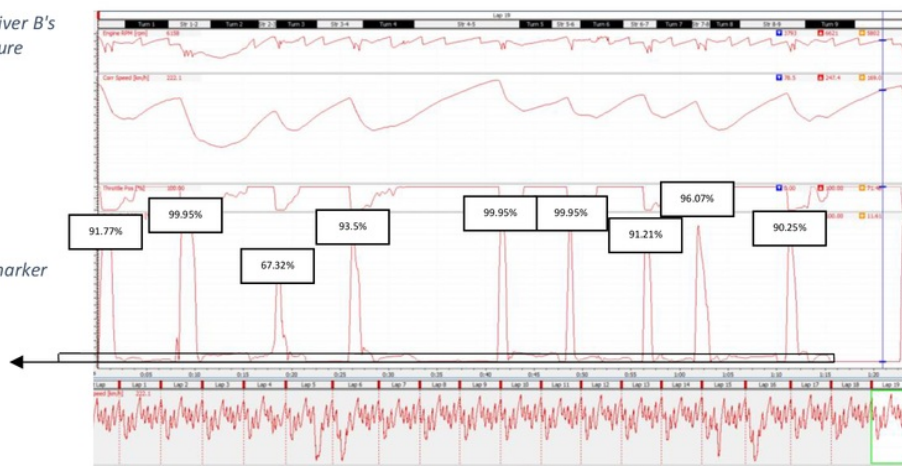
Figure 5: Drivers B's throttle application



When comparing **Figure 5** and **Figures 1&2** it's very apparent the skill of Driver is B in terms of throttle application is lacking when compared. With each throttle sequence it can be seen there isn't a smooth curve or line leading to full throttle. It can be seen throughout different corners "confidence lifts" can be observed. These occur when the driver thinks it's the right time to apply the throttle but then doubts the line they're taking.

Figure 6: Driver B's Brake pressure

Figure 7: Reference marker

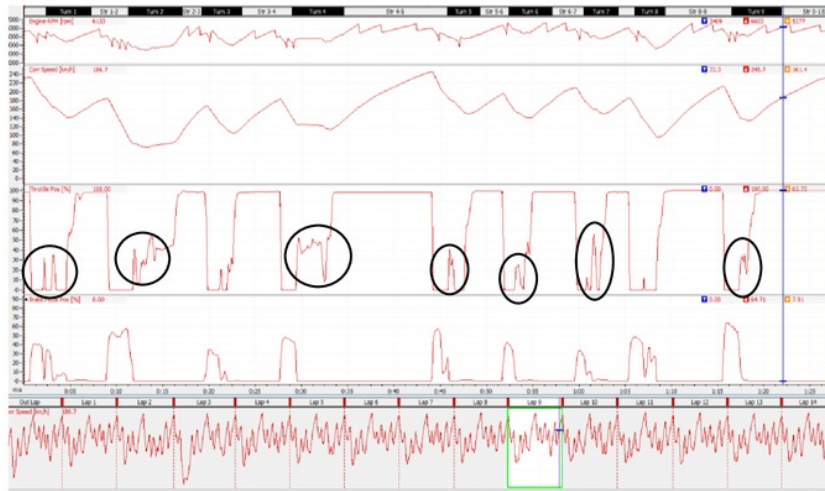


When comparing Driver B's brake pressure usage compared to Driver A is very obvious driver B is heavier on the brakes. Driver B also has worse technique in terms or rolling off the brakes for Trail braking. This very heavy style of braking can lead to braking lock ups leading to wheel locks. Another

thing to observe is **Figure 7**. A reference line has been added to show the zero point on the data trace. When looking at baseline there aren't many points where the brakes aren't slightly applied. This is due to the driver resting their foot on the brake. This accusation is true as Driver B was the driver whom had this trace for session 1.

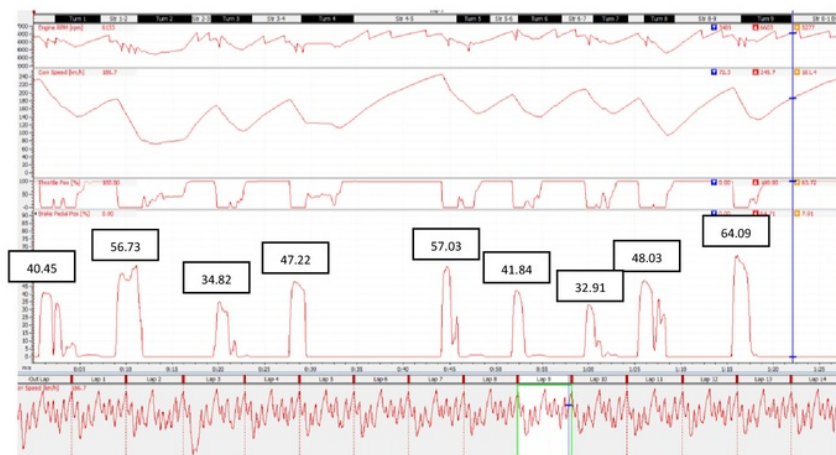
2.3 Session 1 Driver C

Figure 8: Driver C's Throttle Trace



When comparing **Figure 8** to **Figure 1**, the variance in throttle technique can be compared. Driver A in Figure 1 can roll onto the throttle without much hesitation. Whereas Driver C can be seen to be hesitant to fully apply the throttle. This could be due to a bad line, or the vehicle is unstable going through a corner. This hesitation can prove detrimental to the overall lap time.

Figure 9: Driver C's brake trace



Looking at Driver C's braking trace, it's evident that there isn't great force being applied by Driver C. It's also notable that Driver C doesn't seem to have a trend or pattern when it comes to their style of

braking. Very erratic pedal applications show signs of a driver whom is unsure of where the current braking point for a corner is. The driver could also be pulsing the brake pedal to correct a bad line.

2.4 Driver Comparison Session 1

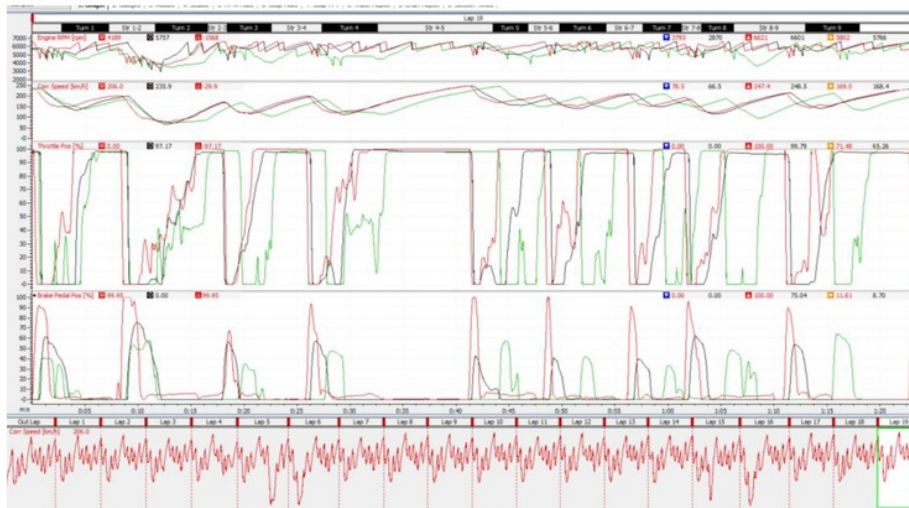


Figure 10: Overlaying Each Drivers Fastest Lap

When trying to find which driver has the better lap time, all data can have overlayed each other to see where each driver applies the throttle, uses the brakes and also when they begin to turn. The lap times from session 1 are as follows: -

Driver A – 1.23.391

Driver B – 1.23.341 (fastest)

Driver C - 1.27.274 (slowest)

Looking at the time that the drivers achieved, Driver B was ultimately the fastest. Although the fastest, it doesn't mean that Driver B's technique is better than either of the other drivers. Overlaying the data, its evident that each driver has a different approach to the track.

Driver A – Smooth Throttle and Braking, good blending between the two.

Driver B – Heavy braking, faster on exit

Driver C – Late braking leading to heavy correcting.

The data was analysed and each driver was given the following instructions: -

Driver A :

- * Turn 5- Reach 100% throttle quicker

- * Turn 8- Brake earlier and get to 100% throttle quicker

- * Turn 1- Brake earlier... to get the line you want for apex

Driver B:

- * Turn slower into turns

- * Brake softer

- * Throttle later and stick on it.

- * Blend throttle and brakes through corners

- * Resting foot on brake through last straight

Last corner/ straight- parasitic braking... resting foot brake

Turn 5- Apex wide... try to get closer to the curb.

Sector 1- Smoother throttle application.

Driver C:

- * Reduce cornering speed- To reduce steering angles

- * Harder braking- wear better shows

- * Earlier on the brakes- higher %

- * Adjust line for turn 2

- * Turn 3- Adjust line, brake harder

- * Throttle sooner on straights- wait for less steering %

3.0 Test Session 2

In session 2 each driver was to complete the session the same as the session before. But as the driver was going around the track several instructions would be actively given to the drivers, in order to try and improve their individual lap times.

3.1 Driver A Improvements

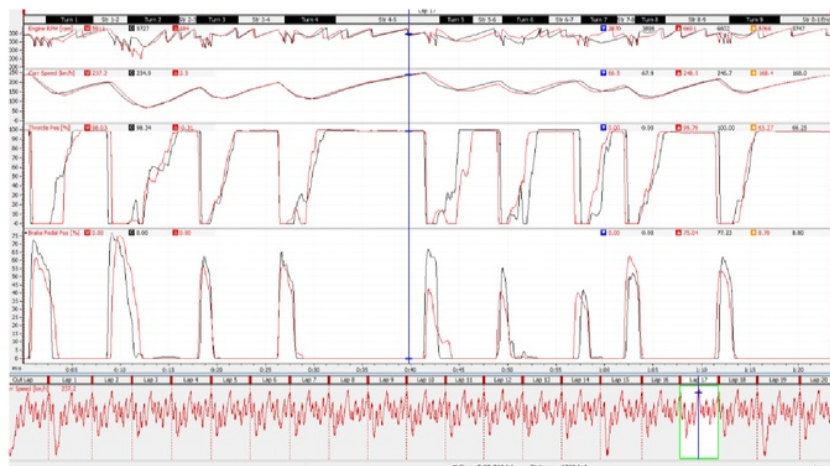


Figure 11: Driver A's Fastest Laps overlay

Trying to improve the performance of Driver A would prove to be the hardest task. Driver A is the most experienced, and also the most consistent driver. When reviewing the data after the first session the following points were picked up:-

- * Turn 5- Reach 100% throttle quicker
- * Turn 8- Brake earlier and get to 100% throttle quicker
- * Turn 1- Brake earlier... to get the line you want for apex

3-minute details over the course of the whole lap is a lot less instruction than the other 2 drivers. The instructions from the other drivers were based on the technique that Driver A displayed.

When giving instructions to Driver A it was noticeable that the instructions would have a delay until Driver A was able to implement them. This would cause some laps to be slower as Driver A was altering their driving style to try and accommodate the instructions. Looking at **Figure 11** both the data traces are still quite consistent with each other. Driver A's consistent driving style was hard to break across the 2 sessions.

3.2 Driver B Improvements

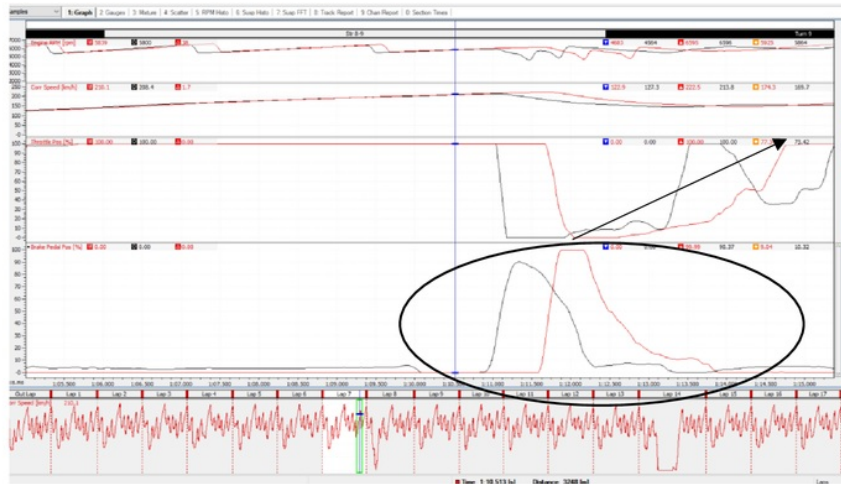


Figure 12: Driver A braking improvement

One of the key areas of improvement for Driver B was to try and improve trail braking and also to brake later. Although the braking force that Driver B was much higher than the other 2 drivers, if wheel lock is avoided the braking force proved to be a big advantage.

Also, another instruction for Driver B was to be smoother on the throttle. This was to reduce cornering hesitation and improve cornering confidence. If Driver B could apply to throttle slower and stick on it, they would gain a better drive off the corners.

3.4 Driver C Improvements

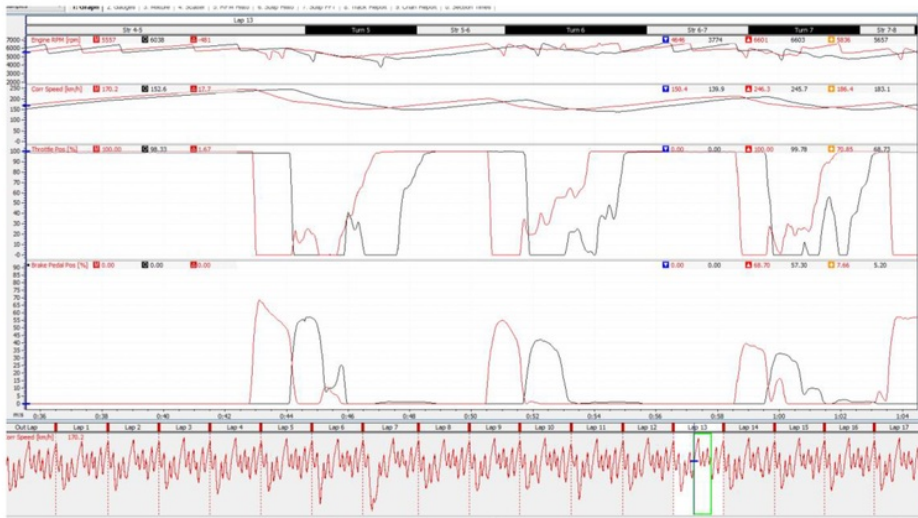


Figure 13: Driver C's fastest laps overlay

Driver C was the driver where the instructions had the biggest affect. In the first test Driver C was having problem with braking. It seemed they were braking nearer to the end of the braking zone than the start. This in turn made him run wide over correcting each corner. Also, when Driver C was braking he wasn't using a optimal braking force. Although braking force wasn't greatly improved the advance in braking proved advantageous enough.

Figure 13 Demonstrates how much sooner Driver C was braking. This in turn allowed Driver C to get back on the throttle sooner, and smoother. Leading to higher cornering speeds.

4.0 Conclusion

Driver A overall time difference = +0.057 seconds

Driver B Overall Time Difference = -0.574 Seconds

Driver C Overall Time Difference = - 2.042 Seconds

When looking at the overall time differences between the sessions, its clear that Driver C made the biggest improvement. This means that Driver C was the biggest beneficiary from the instructions given

Driver B was able to improve their lap by just over half a second. Already being the fastest, Driver B was told to smoothen up the driving like the technique of Driver A. This is an example of how 2 drivers whom use different driving styles can learn from each other

Driver A made an overall time gain. Trying to improve Driver A's consistent driving style proved to ruin the flow of the driver's style and made not much difference. Although the lap time is slower, it's such a small margin that given more instructions improvements could be made.

Ultimately a way that all the drivers could improve their lap times would be to change the car set up to suit each driver. If a driver is experiencing under steer and another isn't then the brake bias or wheel camber could be changed.

5.0 Bibliography