ChassisSim
The Winner's Edge

V8 Supercar Case study

Introduction

The use of vehicle simulation gives a race team the ability to make predictive changes before the race car ever gets to the circuit and thus improve vehicle performance. What this means is that the race team can run through a variety of setup variables so the team can have confidence that the appropriate setup has been worked out before the car ever turns a wheel.

What will be presented here is an application of **ChassisSim™** to a V8 Supercar. In particular what will be shown here is the application of simulation analysis to a V8 Supercar over the course of a race weekend. The setup for this car was deduced entirely using **ChassisSim™**

It will be found that the setup changes over the course of the race weekend closely reflected the setup changes as derived from simulation analysis.

Deducing the initial setup.

To deduce the initial setup an analysis was done of the setup of the previous year. A number of iterative analysis was conducted to deduce the setup to be used for the meeting. The setup changes that where incorporated where,

- Softening the front and rear springs.
- Softening the front roll bar.

A comparison of the setups of this year's setup to last year's setup is shown in Figure 1. As can be seen the 2006 setup favours increased traction and stability through the corners. Given that a novice driver was to be piloting the car this was found to be beneficial. Also a histogram analysis also showed this was an improvement on the 2005 setup.

Once the initial setup was deduced a damper optimisation analysis was performed. This was deduced using the optimization toolbox of **ChassisSim™** The results of the optimization are shown in Fig 2. The optimization dramatically increased the low speed and high speed bump of the front dampers. While some traction was sacrificed, the gain in mid corner speed more than outweighed this. This is shown in the reduction of oscillation of the front dampers. Due to the nature of this increased bump force it was decided to leave this option open for the weekend. As the weekend unfolded it was to be a setup that would be revisited.

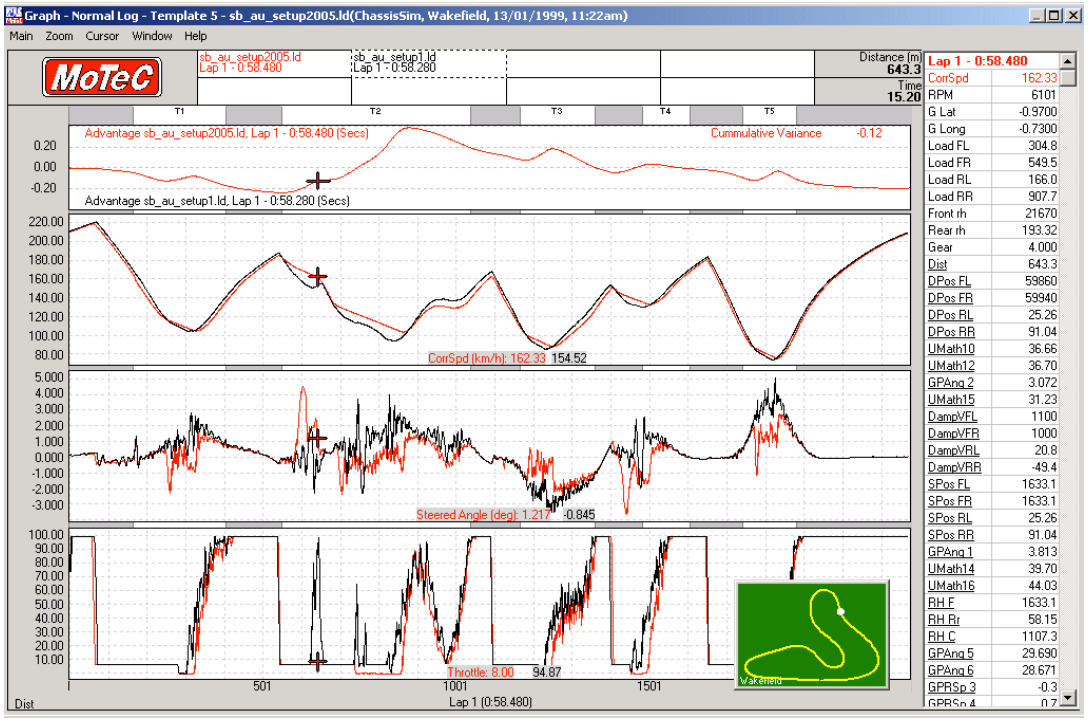

Fig – 1: A comparison of 2005 setup to 2006 setup.

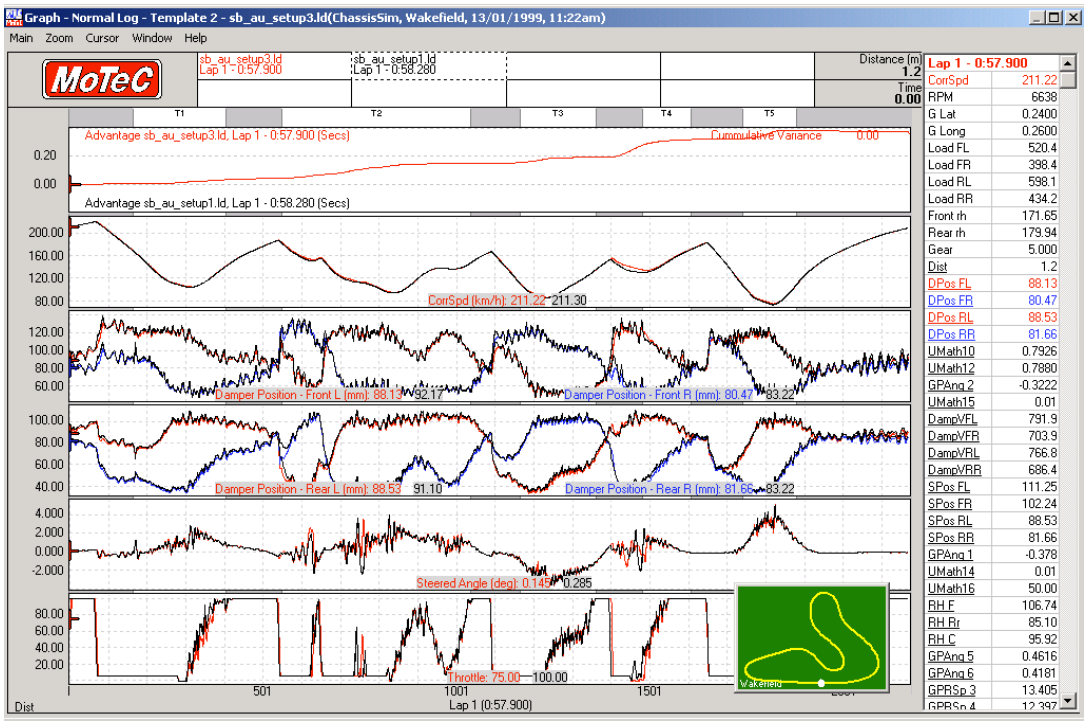

Fig – 2: Comparison of the base setup to the optimized setup Data and simulation analysis of the race weekend.

The car was initially setup with a roll center 10mm lower than the initial specified setting. This was to favour drive and keep some options open. During Practice 1 though the car was found to have too much understeer. An analysis of the data showed the rear roll center should be raised 10mm and the front low speed damping should be increased by 20%. This was found to be highly beneficial for Practice 2. These changes where also simulated. The actual results where shown in Fig-3 and the simulations of this was shown in Fig-4.

It was found the primary gain in laptime was the mid part of the circuit. The raised rear roll centre assisted the understeer but more importantly as can be seen in the data, the front dampers as indicated in the black trace for P2 was found to have less amplitude. This ensured the front of the car had more consistent grip. The gain in laptime was found to be 0.4sec.

The simulation analysis showed exactly the same characteristics. This is illustrated in Fig 4. As per the actual data, the gain in the lap time was in the mid part of the circuit. As per the race data the black trace indicating P2 has less front damper amplitude than the rear, this once again leads to more consistent front grip. This is also indicated in the comparison of the steering traces as well where the steering trace from P2 is more consistent than P1.

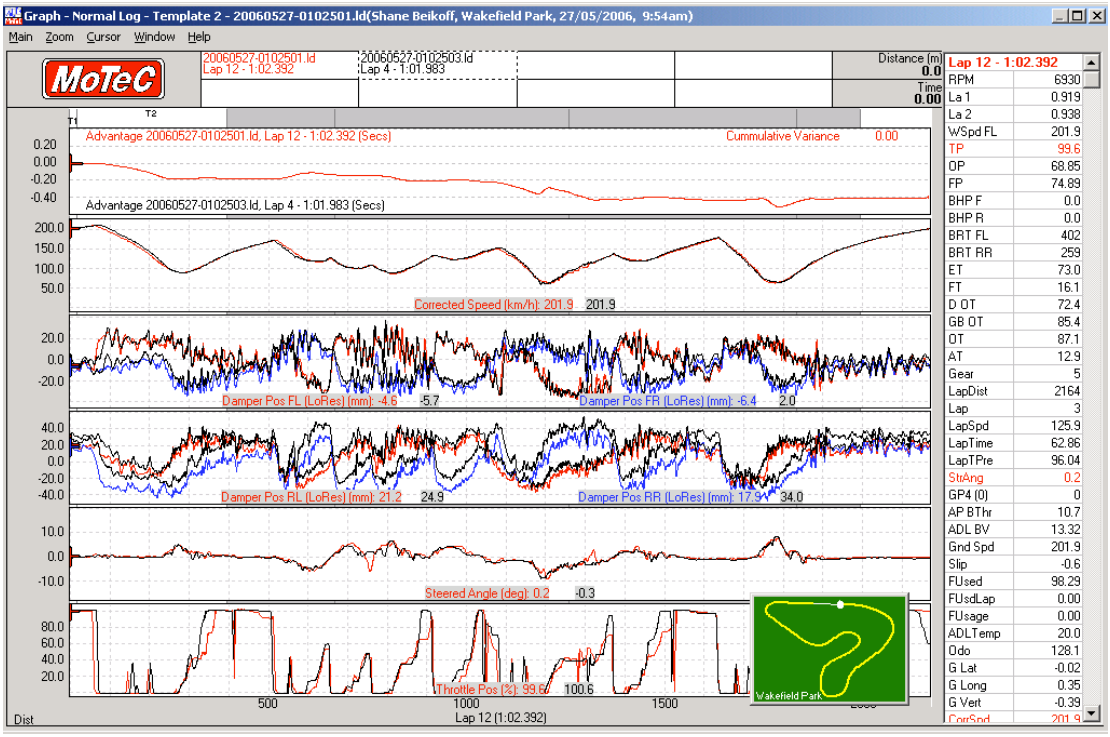

Fig-3: Actual data, Practice 1 data vs. Practice 2 data

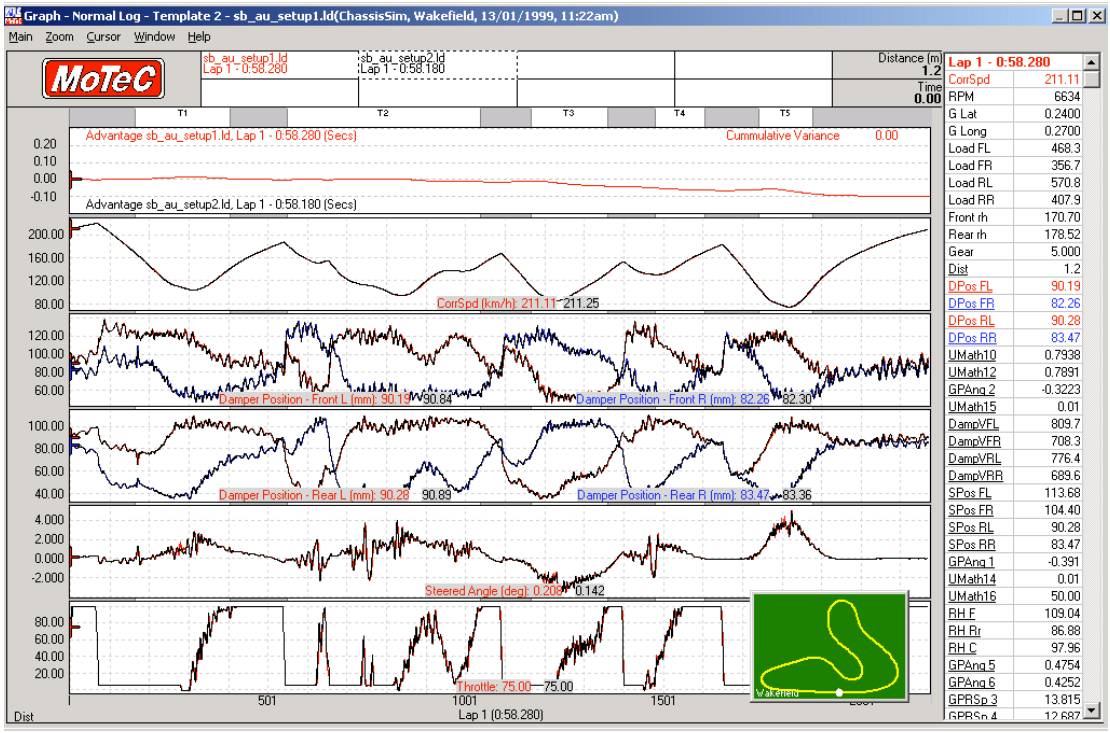

Fig-4:Simulation of P1 vs. Simulation of P2.

The P2 setup was carried into qualifying and race 1 and race 2 (R1 & R2). However data analysis showed the front dampers where underdamped in the high speed region. An analysis of the histogram data and steering traces made this clear. It was decided to increase the high speed front bump as well. The astute reader will recognize that this was the direction the damper optimisation pointed to. Indeed the settings that where finally applied where very similar to the optimised setup. The comparison between R2 and R3 is shown in Fig 5 below.

As is seen quite readily from Fig-5 the biggest gains where braking and the gain in the mid part of the track. As per the difference between P1 and P2. Indeed the largest gain was in the mid part of the track. This was due to the reduced oscillation of the front damper, which led to more consistent front grip. The front damper trace from R3 is shown in by the black trace.

The astute readers will absove the similarities between Fig 2 and Fig 5. The bulk of the gain is in the mid section of the circuit and it is due to the reduction of the oscillation of the front damper. The predicted laptime gain was 0.5s and the actual laptime gain was 0.6s. However more importantly the simulation analysis reflected exactly the logged race data. It should also be pointed out it did this prior to the race car ever turning a wheel.

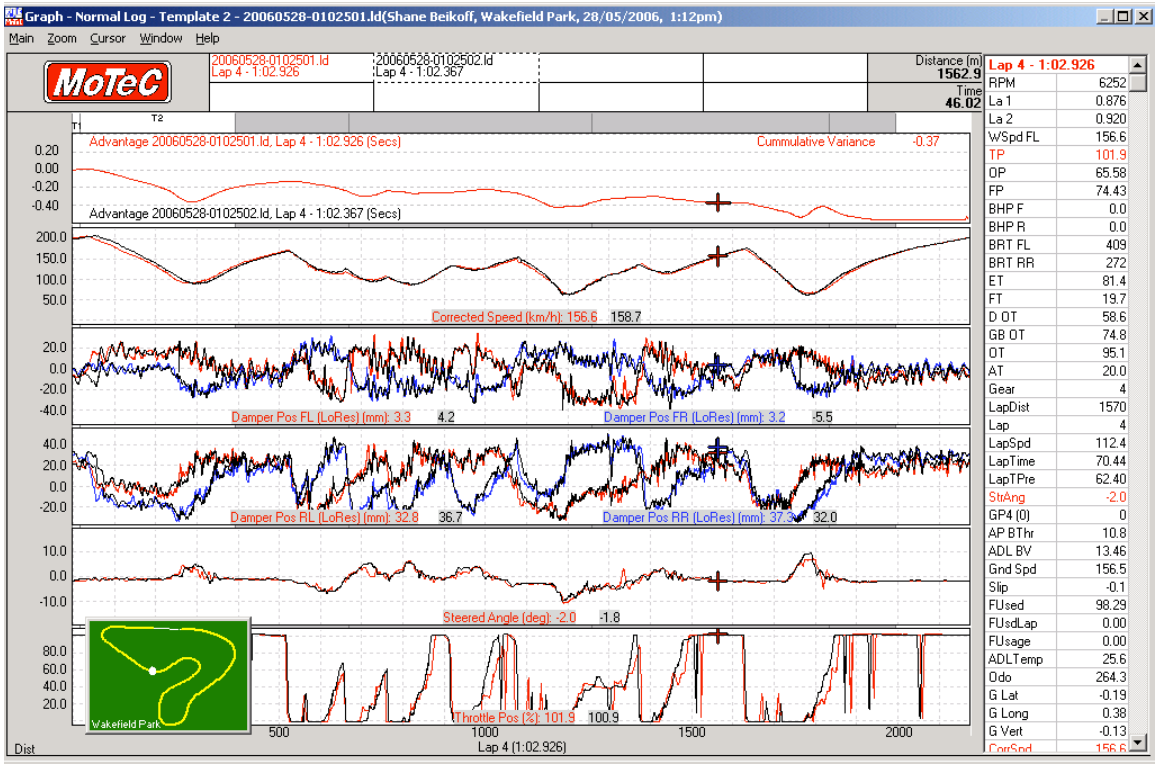

Fig-5: A comparison of R2 vs R3

Conclusion

The data presented here provides a very compelling case for the use of **ChassisSim™** in the setting up of a V8 Supercar. **ChassisSim™** faithfully reproduced every setup change that was applied to the car on the race weekend.

More importantly **ChassisSim™** reflected the fundamental mechanics of why the changes did what they did. One of the fundamental issues that effected the car over the course of the weekend, was the excessive oscillation of the front dampers. This was modeled by the simulation analysis it was identified and the solution was provided by the simulation analysis. This was reflected by the setup changes to the car over the race weekend.

An important goal in race car simulation analysis is to ensure the vehicle model reflects the behaviour of the actual car. **ChassisSim™** has accomplished this goal.

NOTE: Due to confidentiality reasons the actual setup could not be released. This was why differentials where only given.