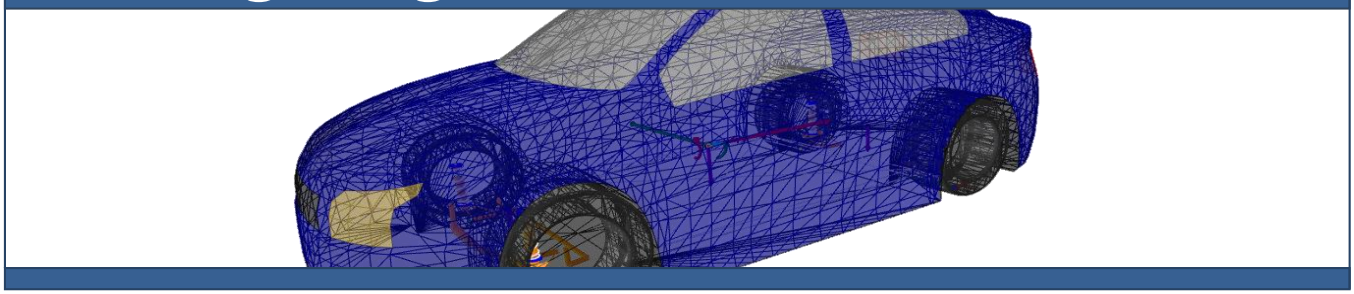
OptimumDynamics - Case Study

Investigating Vehicle Balance



Problem

- To compare the effect of kinematic changes on vehicle balance

Software

- OptimumDynamics

Benefits

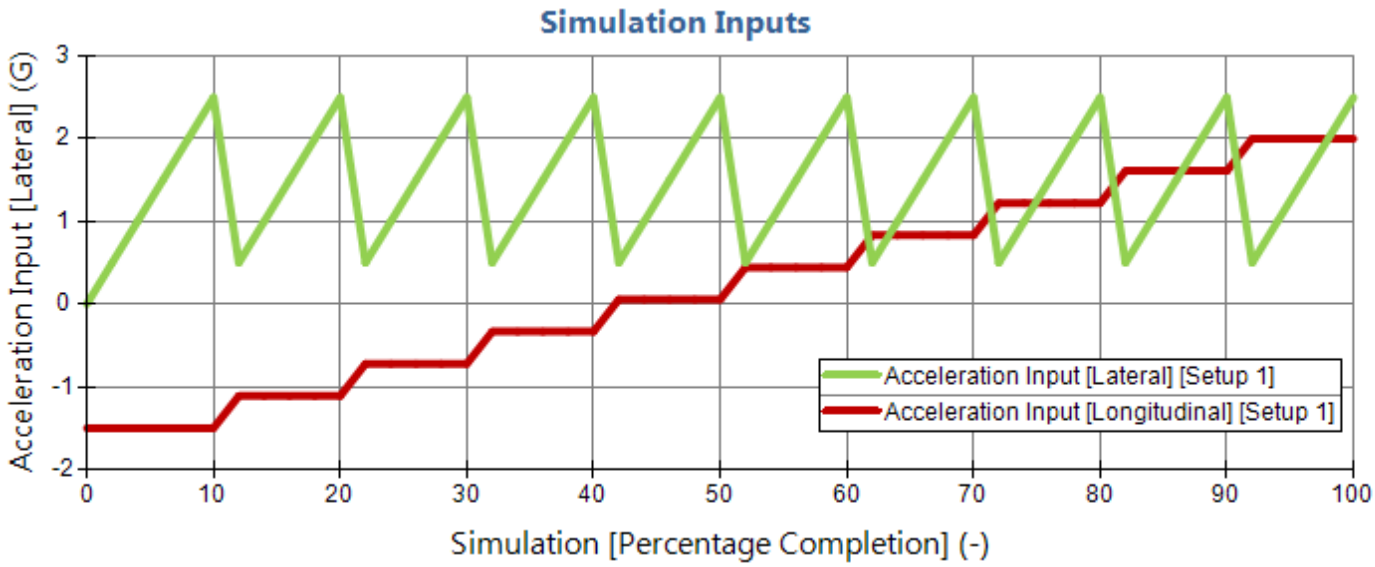
- Simple result comparison
- Easy visualization
- Calculate vehicle balance
- Full vehicle kinematics

OptimumDynamics can be used to predict the handling behavior of a vehicle in different combined acceleration situations. In this study two kinematic setups for a GT racecar were simulated. The percent front lateral load transfer distribution (LLTD) is then investigated for combined accelerations.

This particular vehicle has adjustable pickup points for the lower control arm that will be changed in this study. The effect of pickup point locations can be studied as OptimumDynamics utilizes a full vehicle kinematics model. The analysis of LLTD has been chosen because it can be related to vehicle balance.

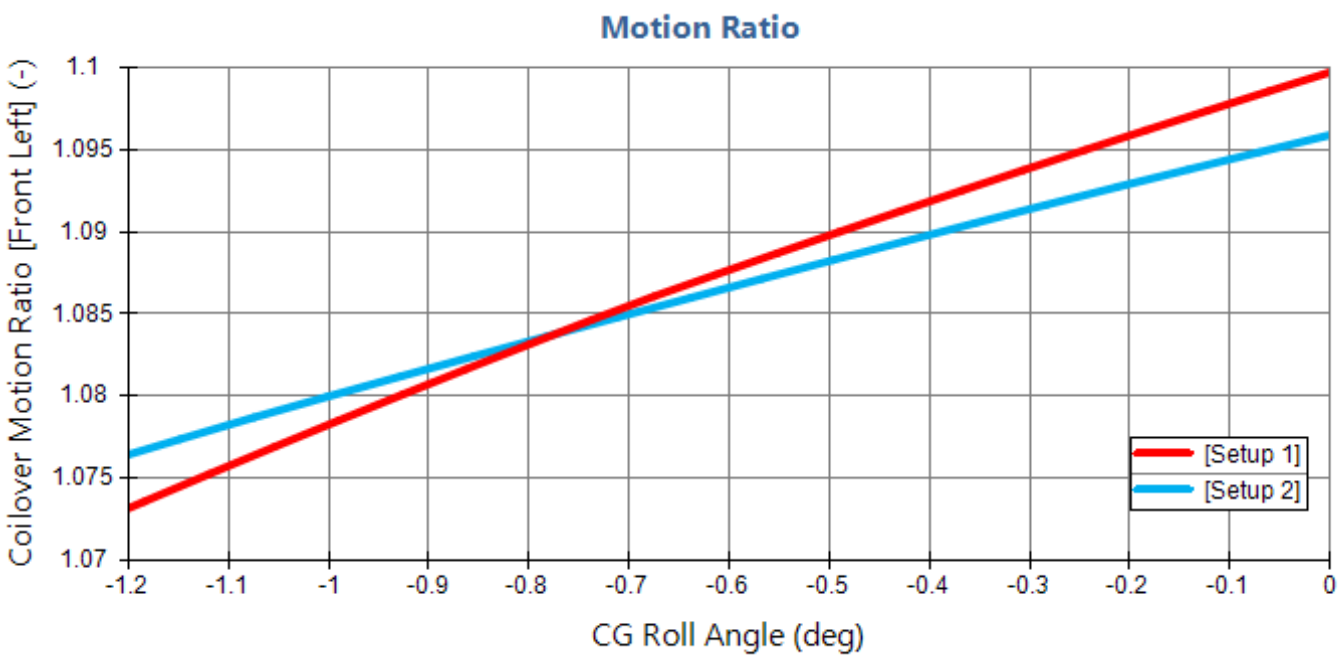
For this analysis we are simulating a combination of lateral and longitudinal accelerations. Longitudinal acceleration is held constant while lateral acceleration is swept from 0G to 1G. This is done for a range of longitudinal accelerations. The inputs are shown on the following page.

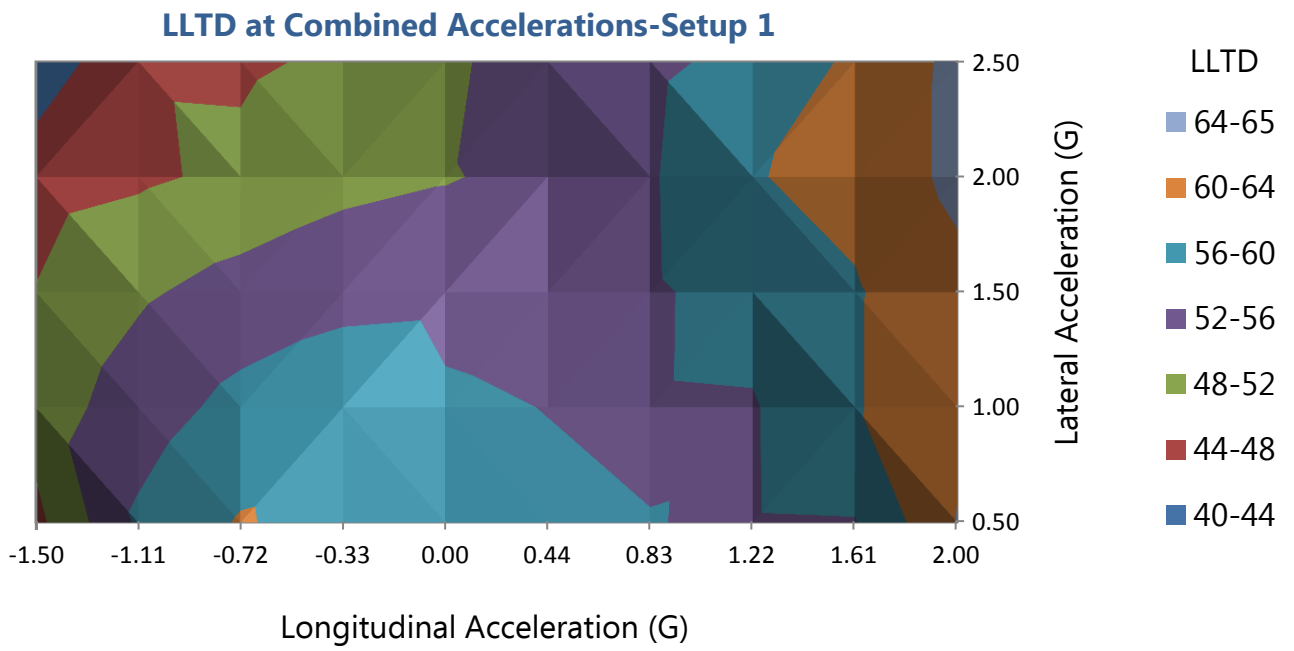
> **OptimumDynamics can be used to predict the handling behavior of a vehicle in different combined acceleration situations**



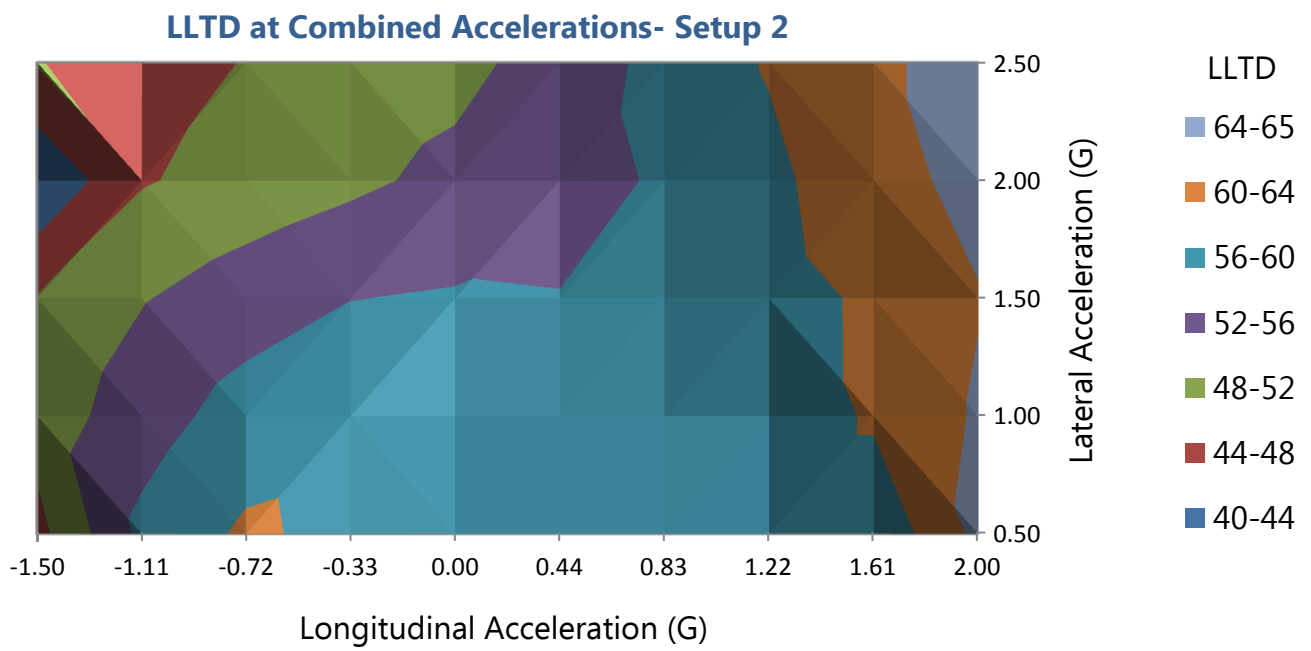
PLOTS - The two vehicle setups were then simulated under the previously described acceleration inputs. Using the built-in charting functions the following 2D Chart was created from the results file. This chart is showing how the motion ratio varies with roll angle.

The 2D chart also demonstrates the difference in the two setups. We can see that Setup 2 has less motion ratio variation with roll, which should correspond to less LLTD variation. The result file data was then exported into Excel for further analysis.



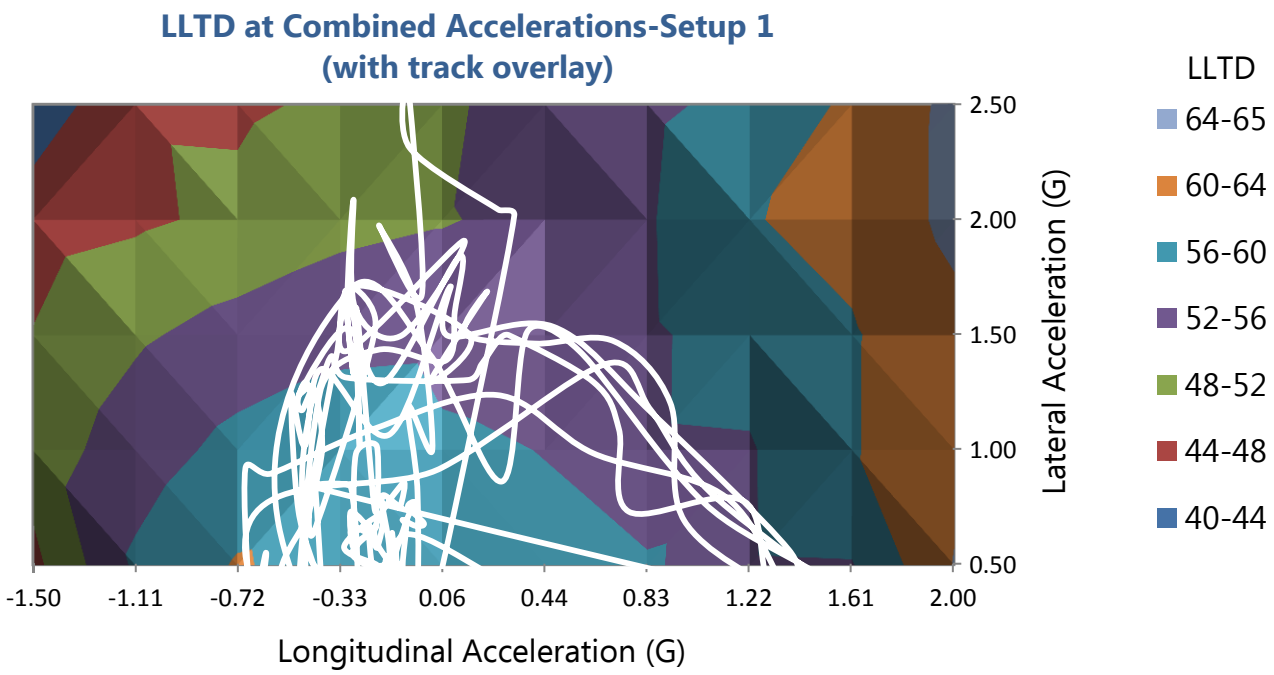


CHARTS - With further post-processing in Excel a contour plot of LLTD with combined accelerations was made. Using these contour plots it is easy to compare how the LLTD for the two setups vary. For example, Setup 2 has a more consistent LLTD for all lateral accelerations in the (0.5 to 1.2) G longitudinal acceleration range. This consistent LLTD should increase driver performance as there will be less change in vehicle balance compared to Setup 1.



Another useful technique that can be applied using OptimumDynamics is a track overlay. In this method we overlay a lateral-longitudinal acceleration trace of the track we are investigating. This allows us to see what part of the LLTD contour plot that the vehicle is actually operating in.

BELOW - The overlay is seen on the contour plot as a white trace. We can see that for this track the vehicle operated mostly in the 52-60% LLTD range. When making tuning adjustments we can focus on changes within this outlined acceleration range.



In this study, the change in vehicle LLTD with combined accelerations was investigated. From these results contour plots were created to visualize the result data. OptimumDynamics made these results possible because of its ability to simulate full vehicle kinematics. We saw that setup 2 provides a more consistent LLTD that can be related to real world improvement.

Analysis

- Results from two setups compared

Post Processing

- OptimumDynamics
- Results Exported to Excel

Conclusion

- LLTD plots generated with OptimumDynamics
- Combining simulation with real world data increases usefulness

About OptimumG

OptimumG is an international vehicle dynamics consultant group that works with automotive companies and motorsports teams to enhance their understanding of vehicle dynamics through seminars, consulting and software development.

About OptimumDynamics

OptimumDynamics is the newest benchmark in computational vehicle dynamics analysis software. It is a versatile software tool that allows you to investigate the dynamic handling and performance characteristics of any vehicle.

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