

# Track Study



## Goals

- Minimize engaging bump stops in specific zones.
- Minimize LLTD variation

## Software

- OptimumDynamics
- Microsoft Excel

## Benefits

- Track Map Visualization
- Full vehicle kinematics

In this case study we demonstrate the full track simulation capabilities of OptimumDynamics. We can create and evaluate multiple vehicle setups for a track.

For this study we look at a GT racecar on the *Circuit de Spa-Francorchamps*. We simulate two setups and look at bump stop engagement and its influence on lateral load transfer distribution. The GT racecar under consideration has bump stops which prevent binding of the damper under high loading conditions.

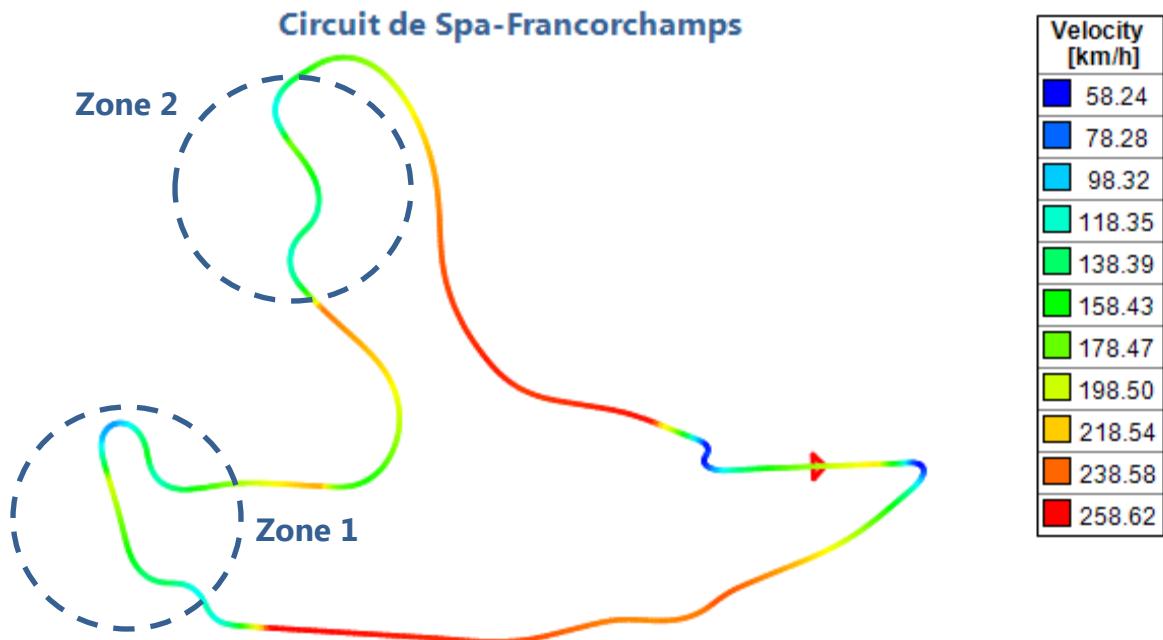
However, engaging the bump stops significantly alters the lateral load transfer distribution (LLTD) which is a metric used for handling of the car. Sudden changes in LLTD will upset the balance of the car. Our goal here is to minimize bump stop engagement and thereby reduce LLTD variation in specific zones.

Using acceleration data for the track, we create a virtual track within OptimumDynamics to be used for simulation. Here we imported the lateral, longitudinal acceleration, and speed data of the car.

From this data, OptimumDynamics can generate a track map to help visualize the track map. We can also color the track map with one of the imported channels. In the following figure we plot the vehicle speed through the track.

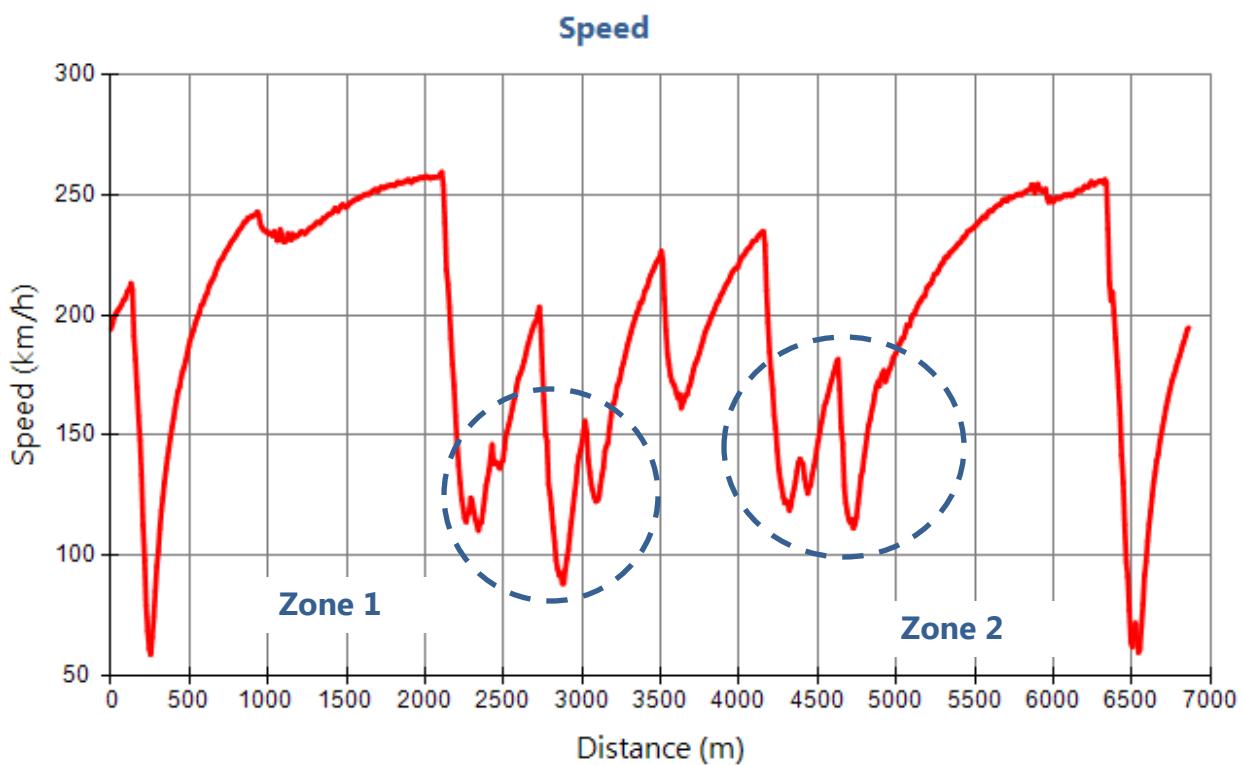
**We can create and evaluate multiple vehicle setups for a track.**



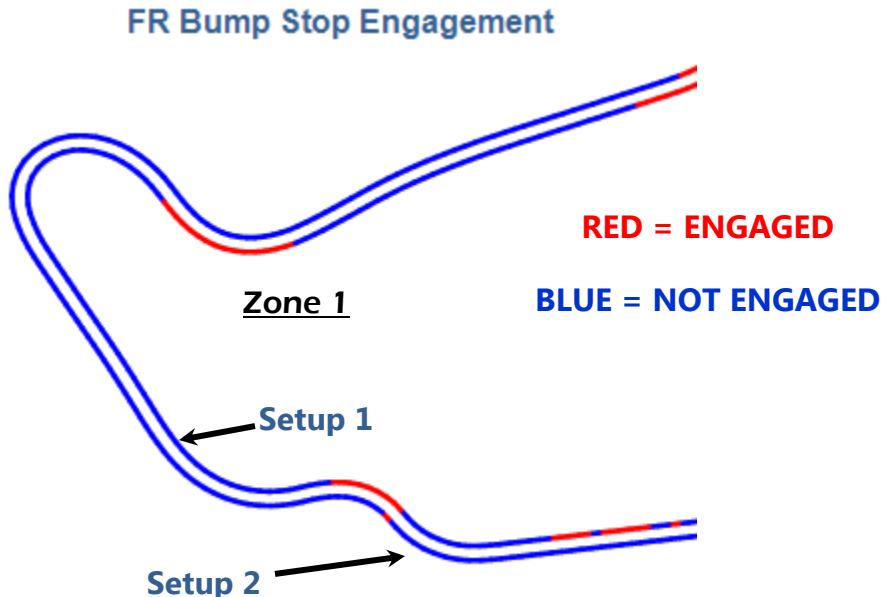


**PLOTS** - The plot above shows the track map colored with vehicle velocity. There are two zones identified – 1 and 2 which we will focus on for our study.

We also plot the speed of the car on a standard 2D plot (below) with the two zones marked for reference.

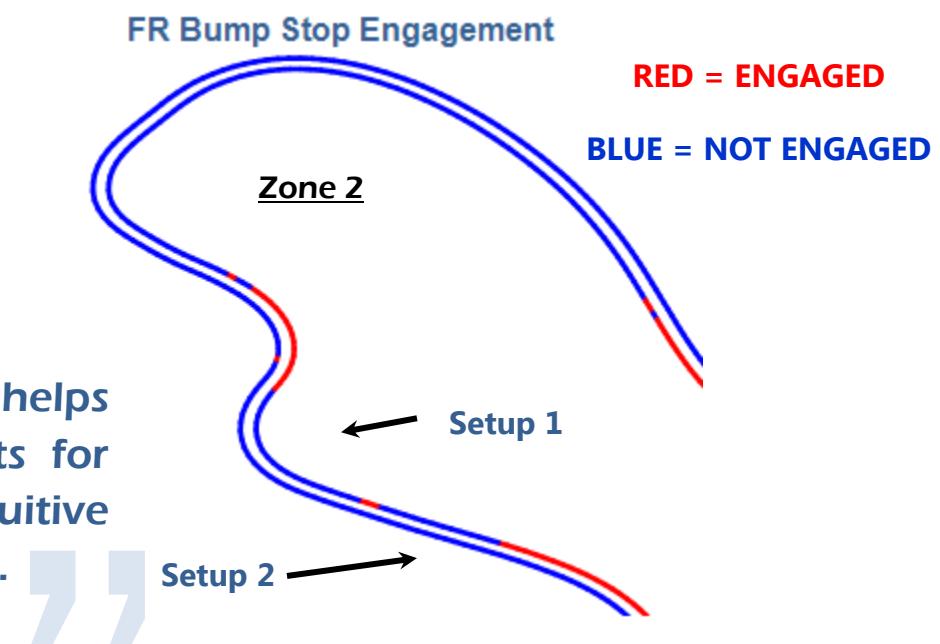


For the following analysis we will ignore the rest of the track and focus our attention only on the two identified zones –1 and 2. First we show the front right bump stop engagement.

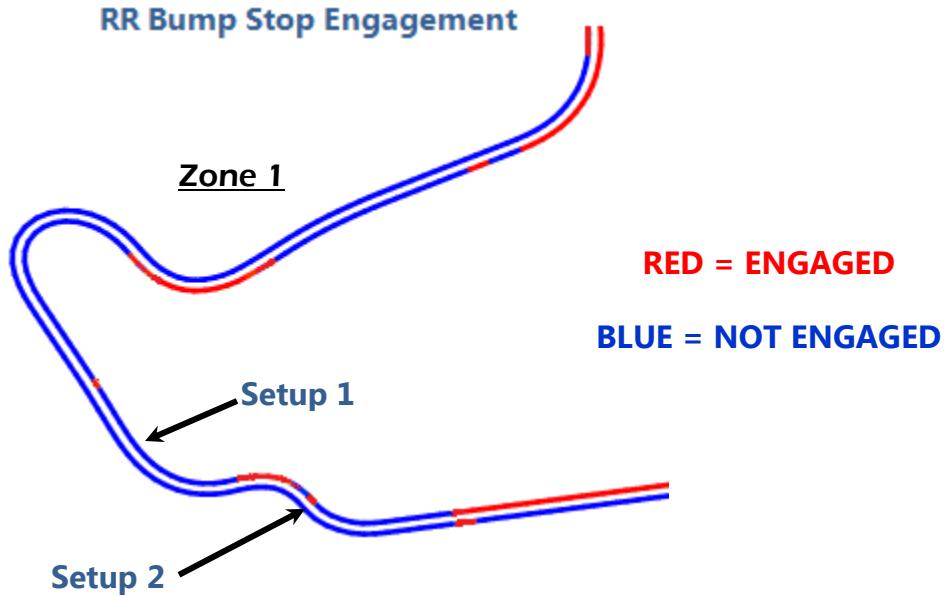


**ANALYSIS** - We plot the results on the track map. The track map helps visualize results for a more intuitive understanding. Also, to make the visualization easier we plot the channel '*Bump Stop Engaged*'

which takes the value 1 or 0. If the bump stop is engaged then it takes the value 1 and is shown as **RED**. Otherwise it takes the value of 0 and is shown in **BLUE**.

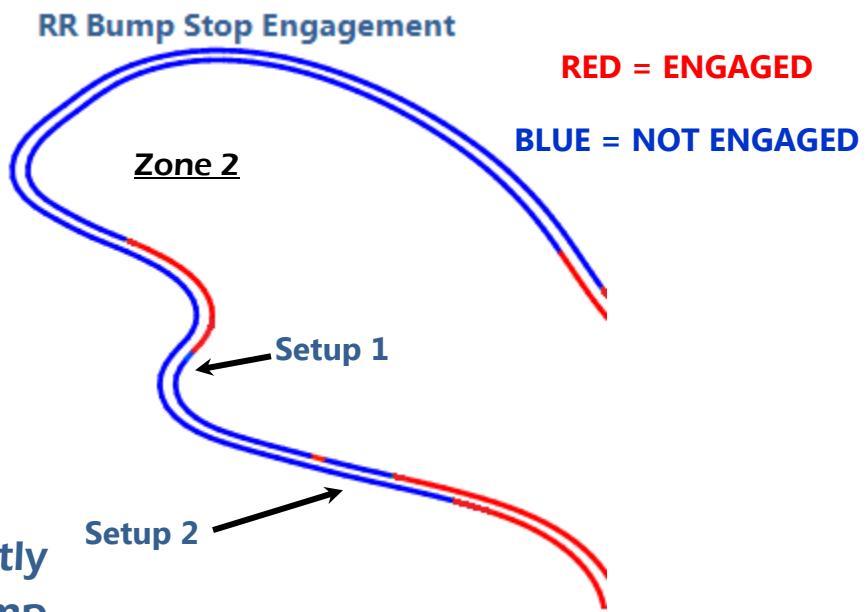


Now we compare the rear right bump stop engagement.



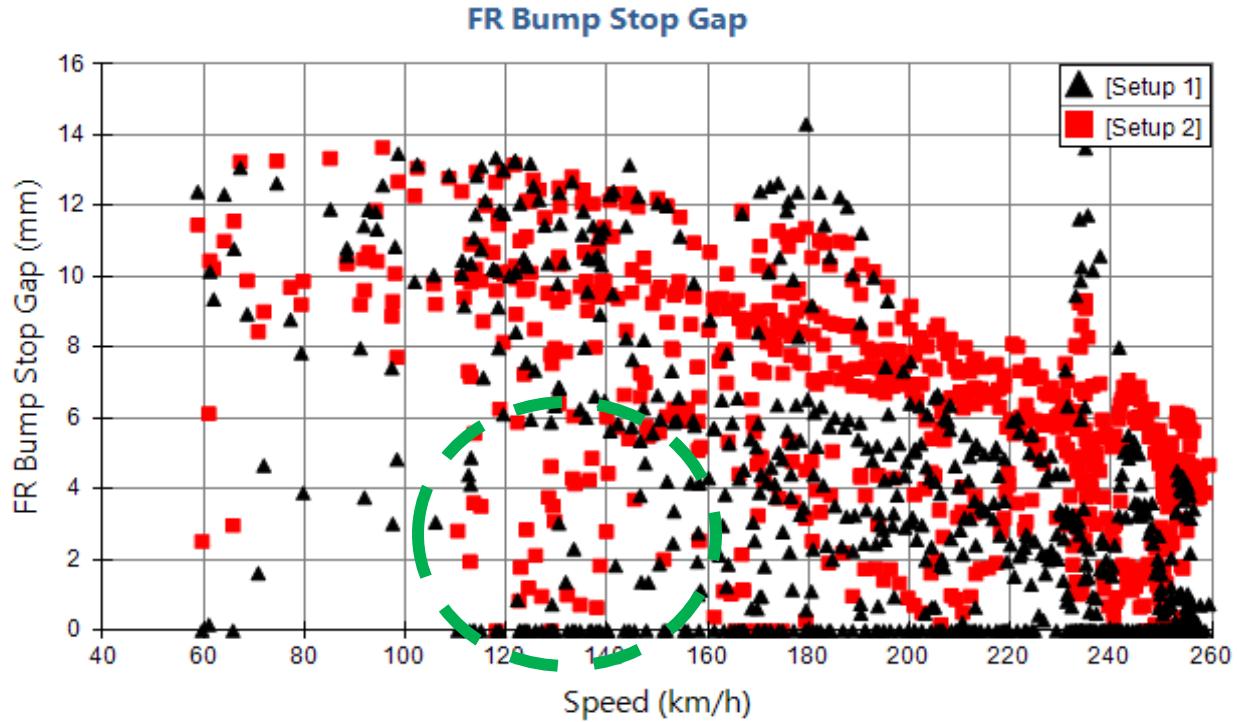
We can clearly see that there is a significant reduction in bump stop engagement for

both, the front right and rear right bump stops with setup 2 in the marked zones.



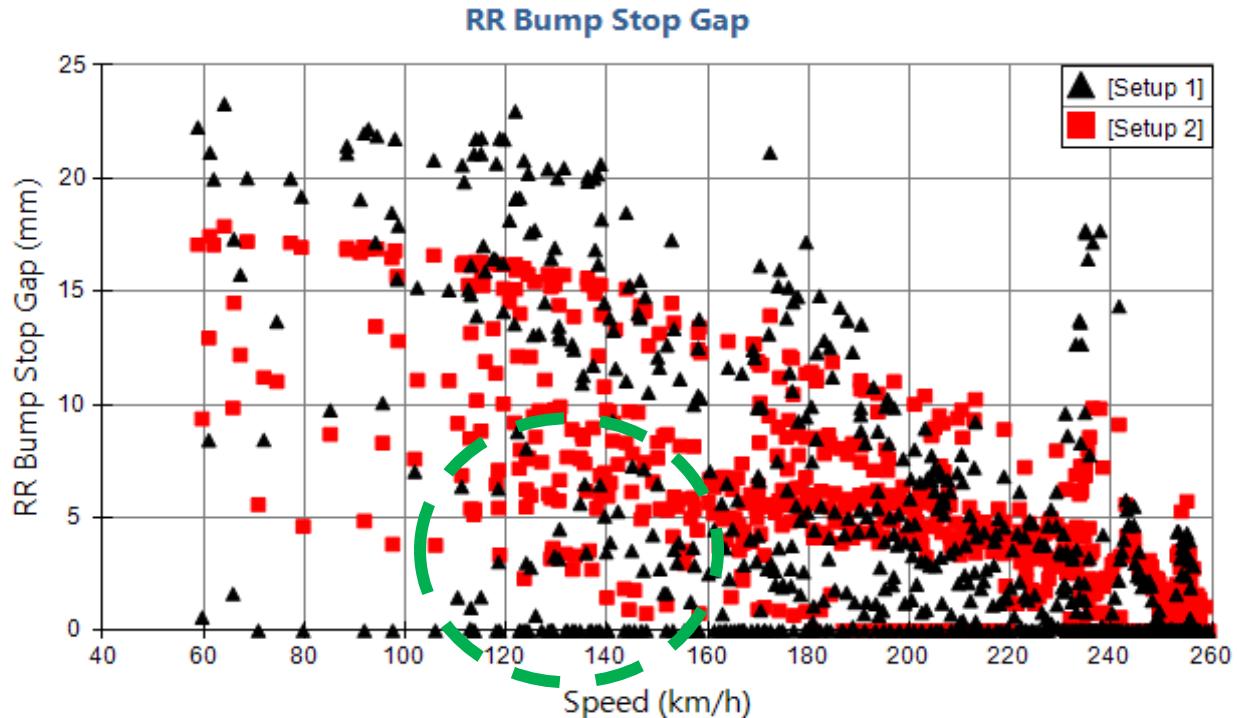
**Setup 2 significantly minimizes the bump stop engagement.**

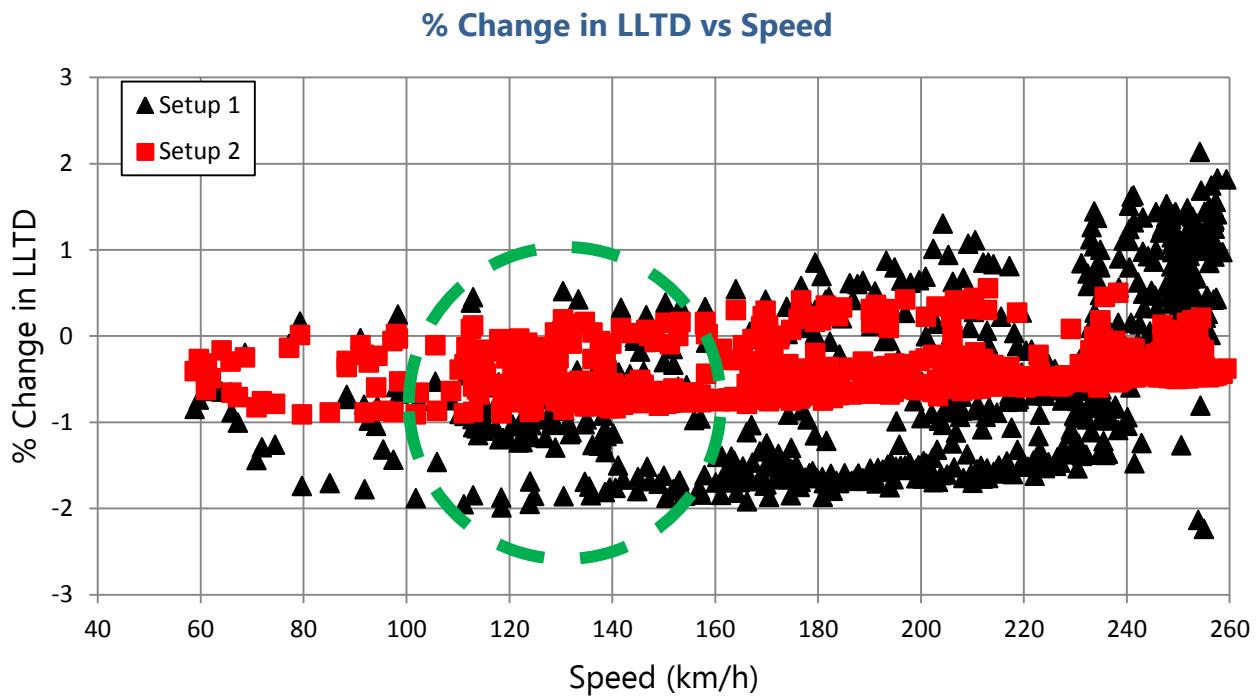




Here we plot the front right bump stop gap (top) and rear right bump stop gap (below) versus speed. A bump stop gap of 0 implies the car is now engaging the bumpstop. We

see that setup 2 significantly minimizes the bump stop engagement in the speed zones circled **GREEN**. This reduces the variation in LLTD which is shown in the next page.





The results are exported to Microsoft Excel and the %change in LLTD for the whole track was calculated. Above is a plot of change in LLTD vs speed for the track. We notice that in the speed zone marked in **GREEN**, the change in LLTD for setup 2 is

This study is just one example of using OptimumDynamics to compare two different setups for the track. The analysis tools within OptimumDynamics help process the results and understand differences between different setups. The results can further be exported to Microsoft Excel for further post processing.

significantly lower than the change in LLTD for setup 1. In fact, the %change in LLTD is lower for setup 2 for the whole track. This implies the car's balance will be more consistent compared to setup 1.

## Analysis

- Results from two setups compared

## Post Processing

- OptimumDynamics
- Microsoft Excel

## Conclusion

- Use OptimumDynamics for track specific study.
- Track Map feature helps visualizing comparison between setups.

## 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.

# **www.optimumg.com**



### **Corporate**

OptimumG, LLC  
8801 E Hampden Ave  
#210 Denver, CO 80231  
(303) 752-1562  
[www.optimumg.com](http://www.optimumg.com)

**OPTIMUMG**   
*vehicle dynamics solutions*

The image shows the OptimumG corporate logo. It consists of the word "OPTIMUMG" in a large, bold, dark blue sans-serif font, with each letter having a vertical stroke. To the right of the "G" is a red stylized letter "H" logo, which is composed of three curved segments forming a loop. Below the main text, the words "vehicle dynamics solutions" are written in a smaller, italicized, dark blue serif font.