Problem
- Find effects of possible ARB combinations

Software
- OptimumDynamics

Benefits
- Test multiple settings
- Easy visualization
- Create a tool to assist tuning

OptimumDynamics can be used to predict the behavior of a vehicle for different setup changes. In this study the effects of the vehicle anti-roll bar (ARB) on percent front lateral load transfer distribution (LLTD) is investigated. This study creates a database of possible ARB combinations; it allows the race engineer to know the effects of the different ARB combinations before arriving at the racetrack.

The vehicle being investigated is a GT racecar. For this particular vehicle we have selected three ARB settings for the front and rear suspensions, creating nine possible combinations in total. The analysis of LLTD has been chosen because it can be related to vehicle balance. If the vehicle is not behaving in the desired manner then the LLTD can be adjusted to change the vehicle balance.

For this analysis we are simulating a cornering scenario. To achieve this, a sweep of lateral acceleration from 0G to 1.2G was simulated for each combination of settings.

It allows the race engineer to know the effects of the different ARB combinations before arriving at the racetrack

BELOW - The graph below was created in OptimumDynamics using the built in graphing features. The 2D chart is useful for visualizing the relationship between two outputs. For this chart we chose to show the how the LLTD varies for the given input acceleration. In the results we can see a consistent trend where the LLTD increases up to a point and then continues to decrease with increasing lateral acceleration. This is an example of how OptimumDynamics is able to take into account the effects of non-linear motion ratios and non-linear spring rates.

LLTD vs. Lateral Acceleration
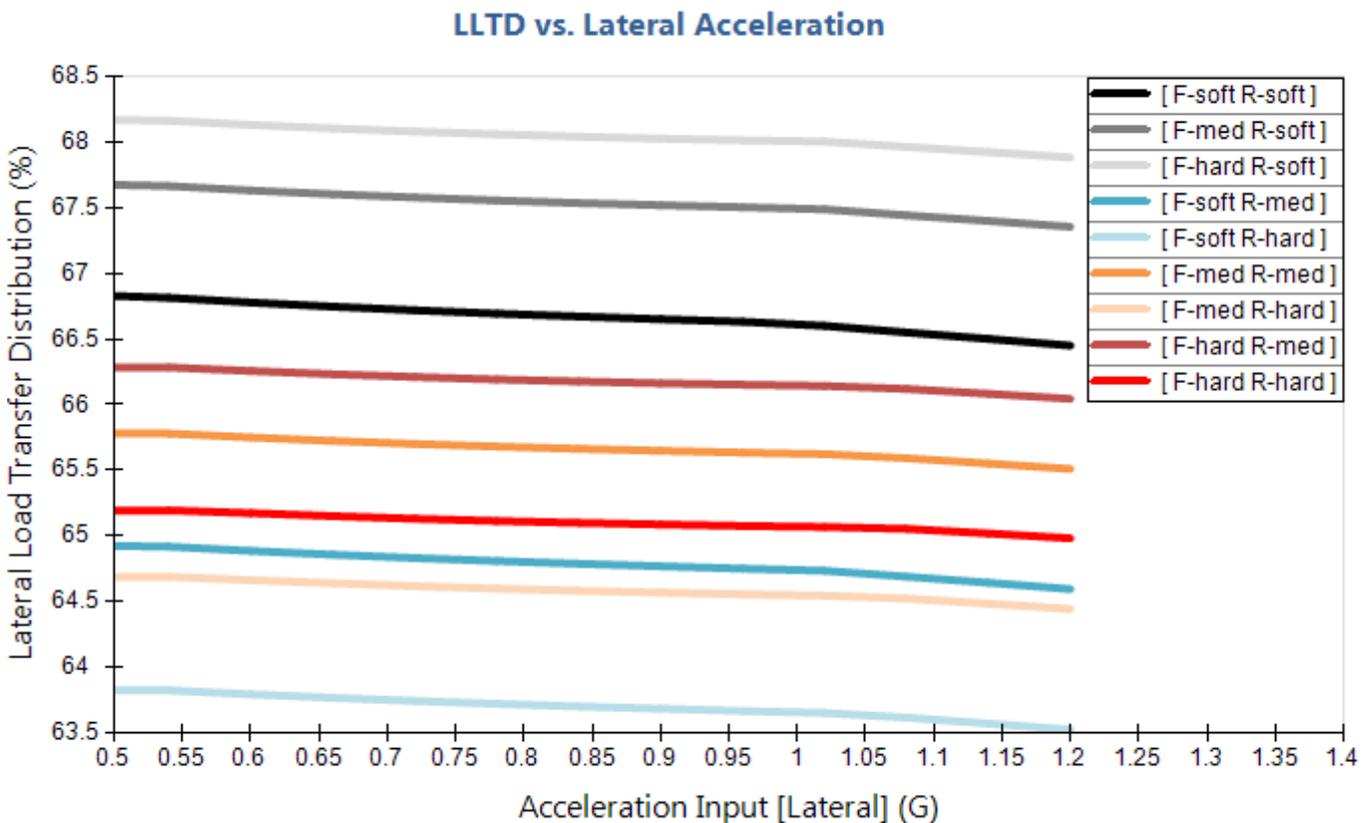
For further post-processing the simulation results were exported into an Excel file. The LLTD was taken for each setup at a single acceleration of 1.2G. This was considered a reasonable approximation as the variance in LLTD between setups had a fairly consistent offset throughout the lateral G sweep. A simple lookup table was then created for all ARB combinations.

TABLES - Looking at the table below it can be easily seen that the different combinations of ARB's will give different LLTD. In this table the darker cells correspond to a higher LLTD. A higher LLTD would tend towards an understeering vehicle. Conversely the lighter cells would tend towards an oversteering vehicle. By looking at the values of LLTD we see changes are roughly between 0.5% and 1% from one cell to the next cell, which is a noticeable difference for a driver. With these ARB settings the overall spread of LLTD is 4.4%, meaning a significant handling change is possible. In addition to the table of LLTD numbers, another table was made to show the percent difference to the baseline settings.

LLTD for ARB combinations (1.2G)				
			Front	
		Soft	Med	Hard
Rear	Soft	66.5%	67.4%	67.9%
	Med	64.6%	65.5%	66.0%
	Hard	63.5%	64.4%	65.0%

% LLTD Change (1.2G)				
			Front	
		Soft	Med	Hard
Rear	Soft	0.00%	1.35%	2.11%
	Med	-2.86%	-1.50%	-0.75%
	Hard	-4.51%	-3.16%	-2.26%

In this study the effects of possible ARB setups were collected. From these results a simple setup tool was created which can be brought to and used at the racetrack. Much like this study of ARB combinations, any setup combination can be studied. OptimumDynamics is an effective tool for creating an extensive database of setup changes for on track tuning.

Analysis
- All possible combinations of ARB settings were simulated.
- An operating range of LLTD was determined

Post Processing
- OptimumDynamics
- Results Exported to Excel

Conclusion
- Simple tuning tool created to help adjust vehicle balance
- Ranges of LLTD are enough to make a difference but small enough to allow fine tuning

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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