

Steering Versus Lateral Acceleration Scatter Plots

By Justin Jang

Two of the most basic sensors for a data acquisition system are a steering position sensor, and an accelerometer. In this tech tip, we'll see how we can use these sensors together to analyze data.

By using a steering sensor we can evaluate driver performance. The more traditional approach involves using a steering trace plotted over a time/distance graph.

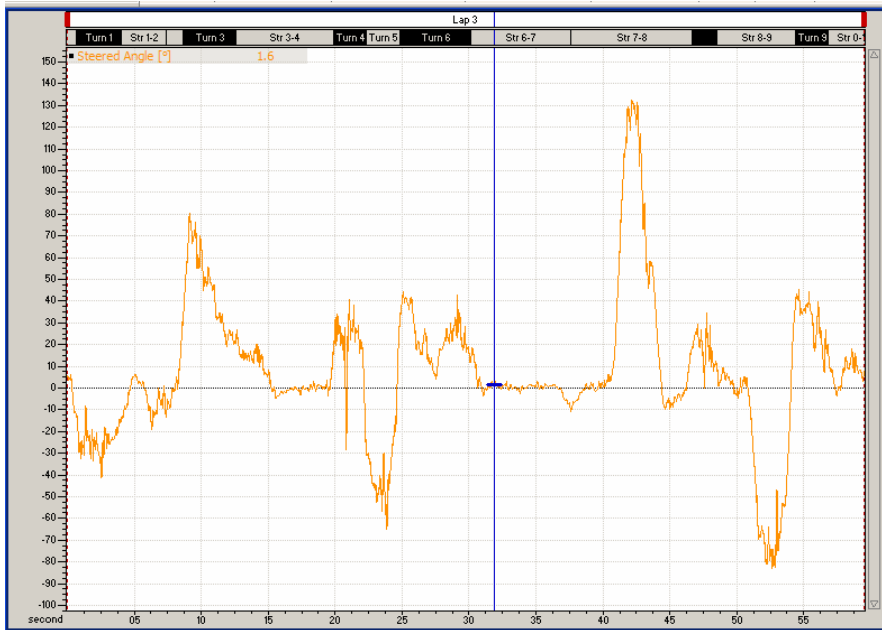


Figure 1

While this graph is easy to read and understand, a scatter plot can give information that cannot be seen on a time/distance graph.

For this tech tip we are going to create a scatter plot in MoTeC's new data analysis software, i2, to analyze steering position and lateral acceleration. The result should look something like figure 2.

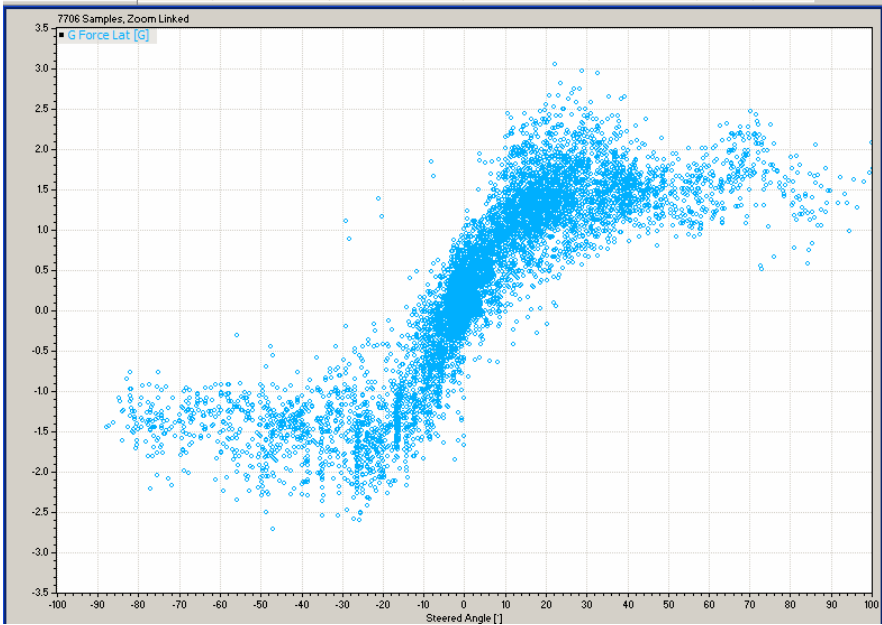


Figure 2

To add a steer versus lateral G plot in i2, we'll start with a new worksheet. Right click in the workspace area to add a new "Scatter Plot". Once you have done that you will see the "Scatter Plot Properties" window, as shown in figure 3.

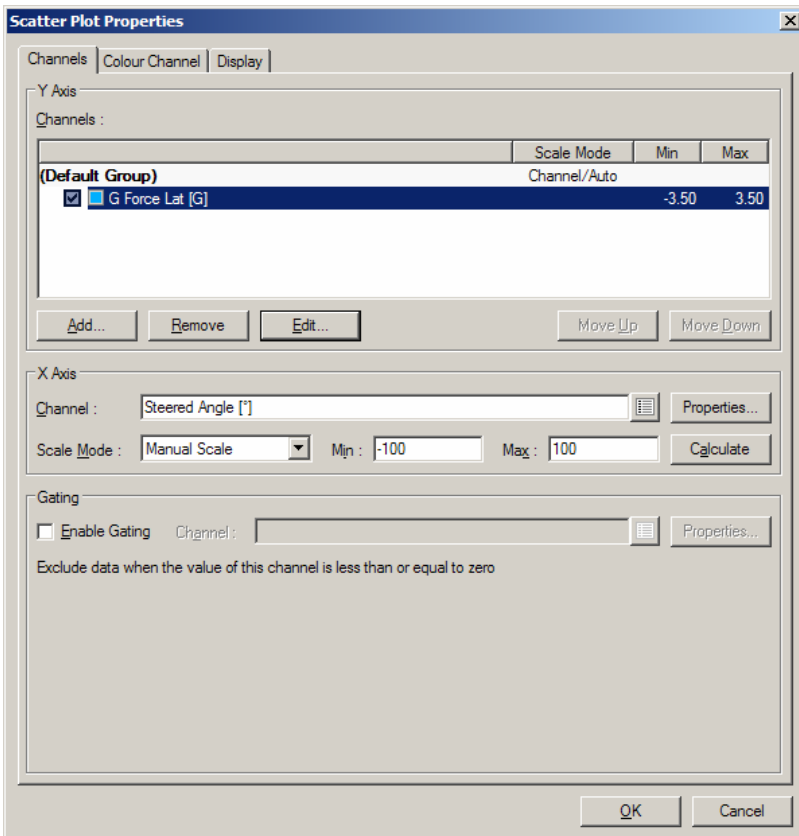


Figure 3

In this window, select the lateral G force for the Y-axis channel, and the steered angle for the X-axis. For this type of graph, it's a good idea to keep the maximum and minimum values symmetrical (for both axes).

What you end up with is a graph of lateral acceleration versus steered angle. The plot will show you where the driver is under, over or at the optimum slip angle. Notice how the scatter plot in figure 1 has lateral acceleration peaks at around 20 degrees. At larger steered angles, the lateral acceleration drops off. This peak shows where the driver obtained the optimum steer angle; a large cluster of points in this region shows more time spent at maximum lateral acceleration.

To get a more detailed analysis, we can enable the color channel in i2 and look at the scatter plot with a third channel. To enable the color channel, right click on the scatter plot, and select properties. Once the "Scatter Plot Properties" window appears, select the "colour channel" tab, and click the check box to enable the color channel (see figure 4).

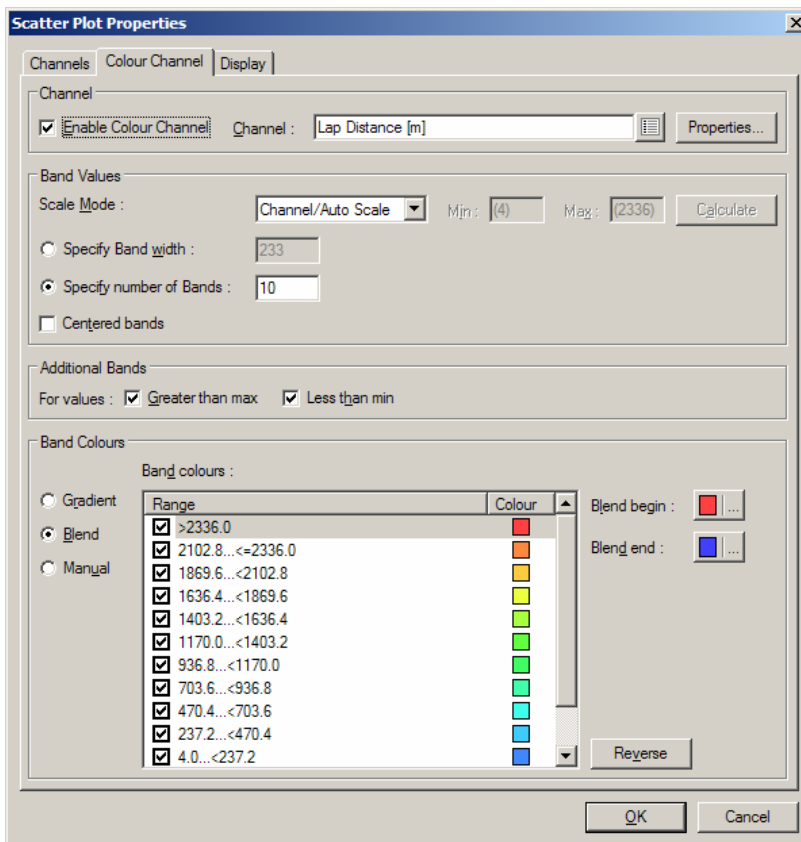


Figure 4

In this example we will use the lap distance for the color channel, but you can choose colors based on total distance traveled (to analyze tire drop off for example), longitudinal acceleration, throttle position, corner loads... the possibilities are endless. We'll use the "Blend" function for this color channel function, with two contrasting colors for a start

and end distance. This will allow us to clearly see different track sections, since the intermediary colors are completely different.

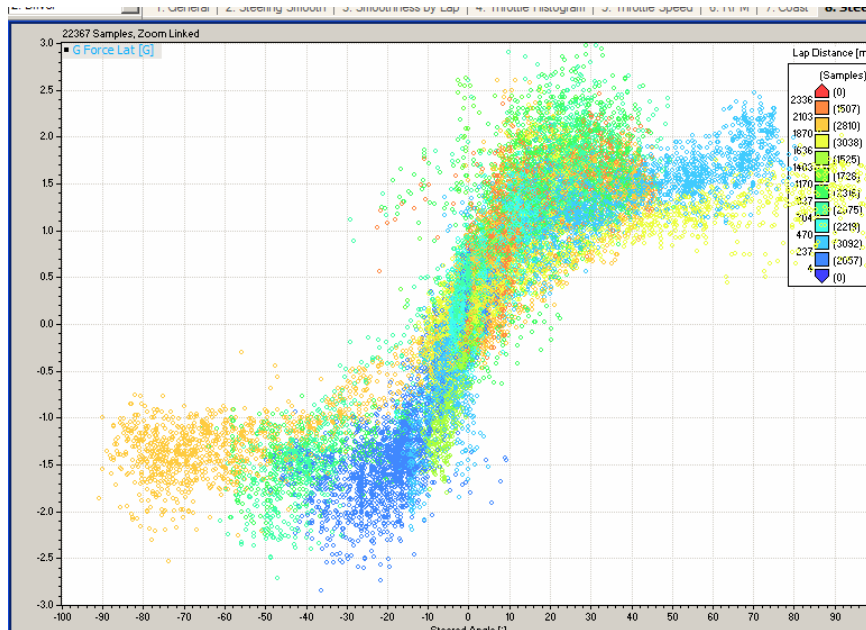


Figure 5

The scatter plot is now gated by lap distance. With this plot we can see different ideal steer angles for different turns along the track. In this example, the dark blue points correlate to the first corner, while the last turn is shown by the yellow points. The different ideal steer angles could be caused by differing aerodynamic loads, banking, road crown, wheel speed... etc. With the color gated as lap distance, we can take data from multiple laps and display a more concentrated data cluster for each corner. This will allow us to see general trends for particular corners. Figure 6 is a rainbow track map with the same color channel settings as the scatter plot in figure 5. This helps to show us which colors correspond to which corners on the track.

As always, for more in-depth knowledge, OptimumG offers 3-Day seminars around the world, in-house seminars, a 12-Day Workshop, simulation, track support, and consulting services.

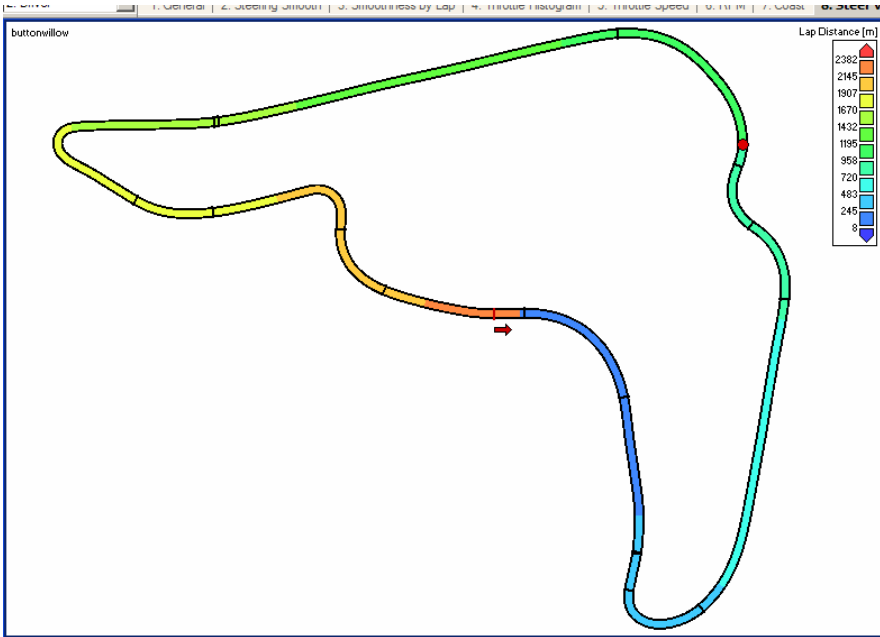


Figure 6

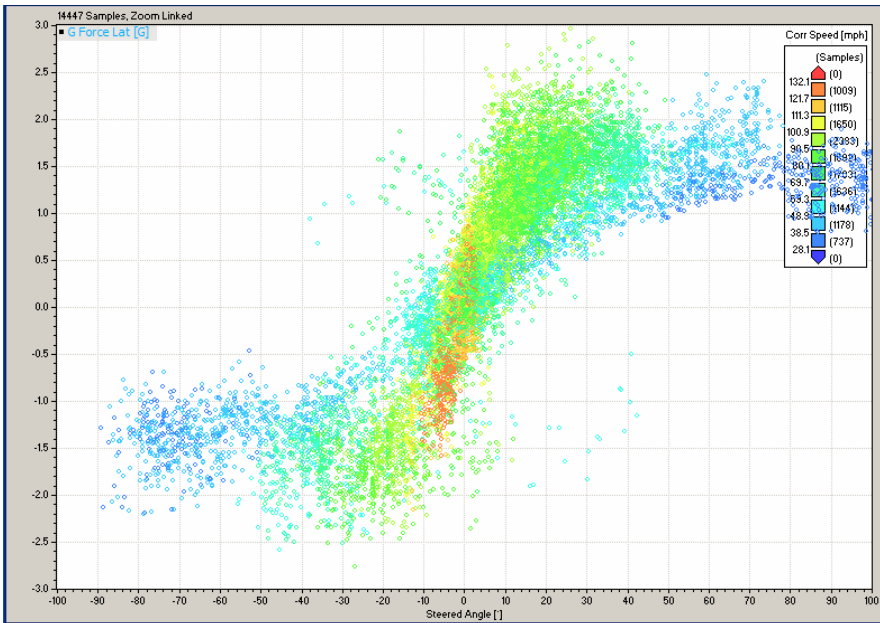


Figure 7

Figure 7 shows the same scatter plot, but uses vehicle speed as the color channel.

By using this scatter plot we can look at data in many different ways, which can help us to understand what is happening with the car, and also better communicate with the driver.

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