Driving the traction circle
Driving the Traction Circle 2004-01-3545

It is time to introduce a new component to motorsports engineering - the driver. SAE papers rarely deal with the cognitive control system which fills the space between the steering wheel and the seat. It seems that only the safety papers admit the presence of a driver, and they treat the driver as a passive object to be protected.

It is the driver who controls the race car. It is the driver who utilizes, or misuses, the capabilities of the car. It is the driver who chooses a path for the vehicle. It is the driver who decides how to use the traction circle to negotiate a turn in hopes of optimizing lap time.

The traction circle is a G-G diagram of longitudinal acceleration as a function of lateral acceleration. It defines the capability of a vehicle to combine acceleration with cornering while exiting a turn or deceleration with cornering while entering a turn. Combining acceleration with cornering is universal because it offers greater control than driving a constant arc at maximum lateral acceleration. Combining deceleration or braking with cornering, often called trail braking, is much more difficult and controversial.

The traction circle describes vehicle acceleration and thus determines the path a vehicle follows. This path is usually called a racing line. This paper will explore the subject of trail braking and test the concept on a simple oval. It will include a literature review of driving books. A mathematical simulation will suggest several lines. These lines will be evaluated on a test oval at the Transportation Research Center in Ohio.

The results will show the effect of different lines and demonstrate effective ways to analyze driver data. The traction circle is a useful analytical concept but it can be deceptive if misused. The traction circle can be augmented with additional information.

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Special Offer: With TechSelect, you decide what SAE Technical Papers you need, when you need them, and how much you want to pay.
The traction circle is a way of thinking about the grip that a particular tire has on the road and how you can use it. Visualize, if you will, a circle, with an x-axis and y-axis running through the center. The edges of the circle denote 100% utilization, the x-axis represents lateral grip (or cornering grip), the y-axis represents longitudinal grip (or braking/accelerating grip). This area in the circle represents the domain of your tire's grip. This traction circle is a way of teaching people the basics of tire grip, the essential limiting factor in performance driving. In the traction circle, you can be either turning left, turning right, accelerating, braking, or a combination of turning one way and accelerating and braking. Duh. The combination of these is often called the traction circle. The topic is an introductory chapter in nearly ever recent racing book. The idea is that you only have so much grip in your tires. You can use this for cornering, accelerating, braking, or some mixture. In the traction plot below, focus on the blue dots. This is the output from a TraqMate from the people at Race Optimal. I have overlaid a circle and a diamond. As you can see, neither one fits. Is TraqMate plotting the sum of the accelerations (diamond expected) or computing the sum of force vectors (circle expected)? I don't care. Neither one is correct. The true nature of traction isn't that simple. Does this apply to your car on your favorite track with you driving? Only one way to find out: Advertisements. Traction Circle 0.2. Plots Acceleration/Traction information to assist optimal cornering performance. Overview. Reviews (1). Version History. Support. Plots the acceleration values (G) of the car so the driver can see how well the interaction with traction during cornering and breaking. Keeps the last X seconds worth of observed values and automatically fades them by age (brighter green values are more recent) leaving a trail. Additionally a moving average of the accelerations is plotted in white. Great to watch, Not really sure how to best utilize to improve my performance, but still fun to watch. Keep the line from leaving about the size of a dime makes for smooth piloting. Jun 29, 2014. Show Ignored Content.