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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Author(s): Wm. C. Mitchell, Roger Schroer, Dennis B. Grisez

Affiliated: Wm. C. Mitchell Software, Transportation Research Center

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The traction circle Tyres are responsible for providing a connection between the car and tarmac, and it’s through this connection that the driver is able to accelerate, brake and corner. The most important thing to recognise is that there is a finite limit to the amount of grip or force which can be produced in any direction. To define this, we can visualise a diagram called the traction circle. Using the full traction circle in all directions Again back in 2.4 Driving basics, we recommended that the beginner driver entirely separates their braking, steering and throttle inputs. Whilst this is a good approach for the novice, it is clear that this driving style does not fully exploit the full limits of the traction circle and the diagram instead will look more like the following. The Traction Circle is a dynamic way in which the car's tyres/tires interacts with the road surface when driving. It is a easy way of teaching people the limits of the tyres/tires on the road, which ultimately determines the overall performance of a car. If you imagine the circle above which is divided between the Cornering G-Forces of the tyre/tire ( left to right) and the Braking and Accelerating forces ( Bottom to top). But this time the front tyres/tires of the car reached the traction limits available first and the rears still had some grip in reserve left. We would called this Understeer and if we increased the throttle pass the limits of the tyres/tires even more, the car would have a tendency to push straight ahead and not turn in. Tests are conducted on sandy loam to determine the traction performance of the TDCDW. The drawbar pull and the slip of the 2WD truck with TDCDW are measured by the dynamometer vehicle. The soil resistance of 2WD truck with TDCDW is got by pulling the wire rope fixed on truck with the winch and reading the load cell fixed on the wire rope. The main results of this study are: The load on the front wheel has no influences on the tractive effort of TDCDW on sandy loam. The slip of the vehicles with the TDCDW is not the simple assembled slip of wheel on TDCDW and TDCDW on sandy loam. When the load