Running away from everyone in the rain is how The Professor won the Pilote Elf

The Theory of Slow Turns in Automobile Road Racing

http://www.tinyurl.com/thetheoryofslowturns

It is amazing how many drivers, even at the Formula One level, think that the brakes are for slowing the car down. -- Mario Andretti

Abstract

This paper presents the claim that there is an application of Game Theory to the topic of negotiating turns in automobile road racing: that there exists a best possible play, and what that is; at least in the type of turn which is most important..

Prerequisite Information

There are two pieces of background knowledge the reader must have at this point: the definition of slow turns, and the braking and turning force fundamentals.

1. Definitions

Fast turn: One for which one you as the driver would not lift
Medium turn: One for which one you would lift and perhaps brake lightly to moderately
Slow turn: One for which you would brake hard and deep into; perhaps ⅓ - ½ way
Apex: A.K.A. the clipping point, the middle of or tightest point in a turn

2. Force Vectors

This theory accepts as correct the assertions regarding the forces acting upon the car made in "The Technique of Motor Racing" by Piero Taruffi[**1**].

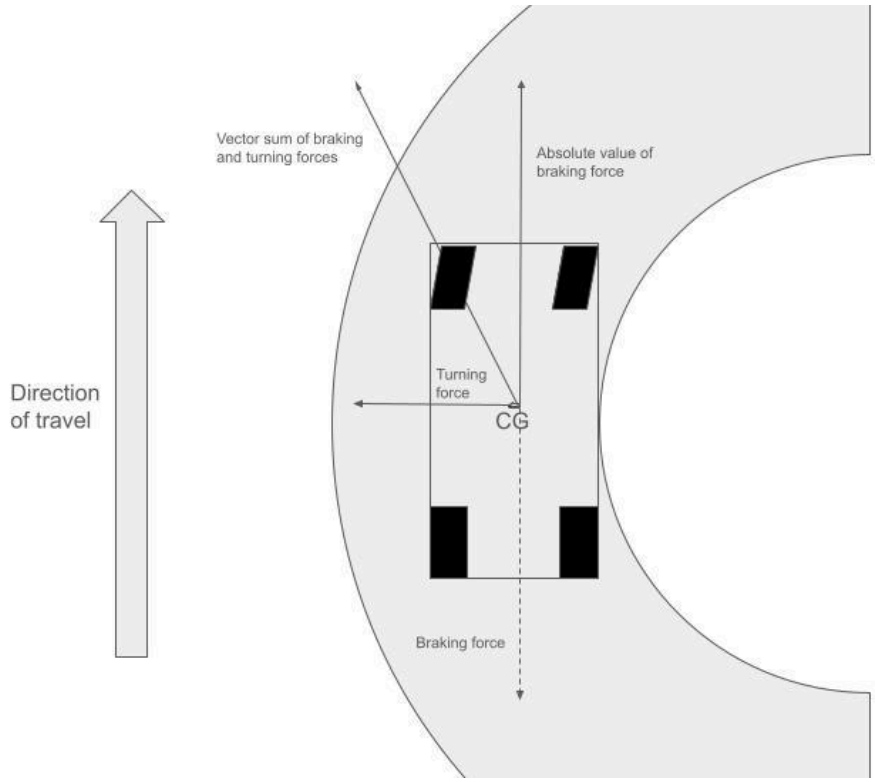

Figure 1. Forces acting on a car in a turn.

Figure 1 shows the forces. The braking force is towards the rear of the car; we are more interested in its absolute value. Taruffi claims that when the vector sum of the braking and turning forces exceeds the available traction, the car will leave the road, and in the direction indicated by the vector.
This diagram presently has this error: the car is shown in the middle of the turn, when the brakes should be fully off, but the braking force vector is not drawn with zero length.

Theory

1(a) Postulate 1

At the end of the straightaway the driver must be braking as hard as is possible without locking the wheels. In other words using as much of the available traction by braking as is possible without using it all.

1(b) Postulate 2

At the apex of the turn the car should be going around the turn as fast as possible without losing adhesion and subsequently leaving the road. In other words using as much of the available traction due to turning as is possible without using it all.

1(c) Assertion

The optimal driver behavior between the entrance of the turn and the apex is to release the brakes in such a way that the magnitude of the vector sum of the braking and turning forces is kept constant at the value which requires as close as is possible to but without equalling 100% of the available traction.

1(d) Corollary Hypothesis

For every car: For every slow turn, there is a single fastest {entry speed,de-braking curve} pair.

Comments

"Thus, for Poker players, Game Theory bears fruit. Game Theory tells us that for every recognizable poker situation we can name, there is an optimal strategy. The strategy may be too complex for us to discern, but in theory there is one."

- Ankeny, Nesmith: Poker Strategy: Winning with Game Theory

Game Theory also tells us that given identical cars, for every slow turn, there is a single optimal de-braking curve which permits the single fastest entry speed. It's not an easy sum to do, but that's what it is.

References

1. Taruffi, Piero: *The Technique of Motor Racing*, 1959, Motor Racing Publications
2. Ankeny, Nesmith: *Poker Strategy: Winning with Game Theory*, 1982, Basic Books
3. https://www.tinyurl.com/dklelfrenault, 1989