Simulating the Relative Influence of Factors Relating to Forward Collision Accident Rates

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Question

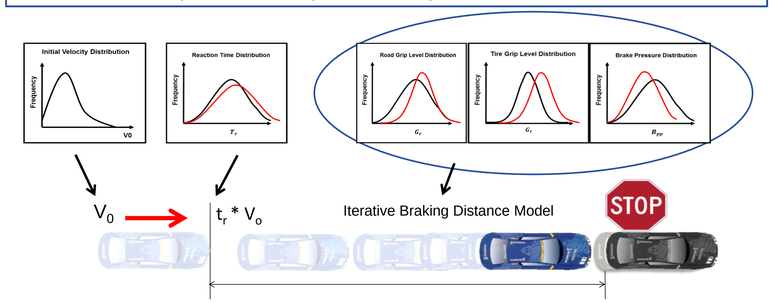
In a world of evolving vehicle technologies such as ABS, forward collision warning (FCW) and automatic emergency braking (AEB), and autonomous vehicles, how much impact do tires have on vehicle safety? Is it still necessary to consider braking performance levels when selecting new tires or do these new technologies make it unnecessary to invest in higher performing tires?

Simulation

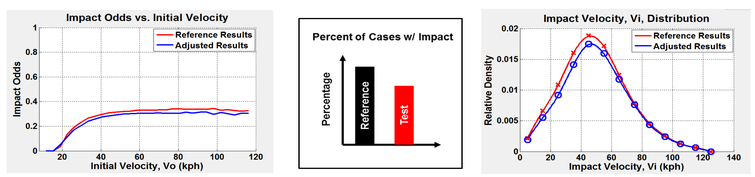
A Monte Carlo Forward Collision Simulation has been developed to estimate the relative impact of various vehicle collision parameters. The model takes distributions of these parameters as inputs and outputs a risk of collision for a test case relative to a known reference case. The parameters that can be studied include: tire grip level, road grip level, vehicle velocity, following distances, and the presence of vehicle technologies (ABS, FCW & AEB).

How Does the Simulation Work?

Randomly chooses 500k samples from input parameter probability distributions



Iteratively Runs a Forward Collision Simulation on Wet Roads Including Vehicle Technology Logic

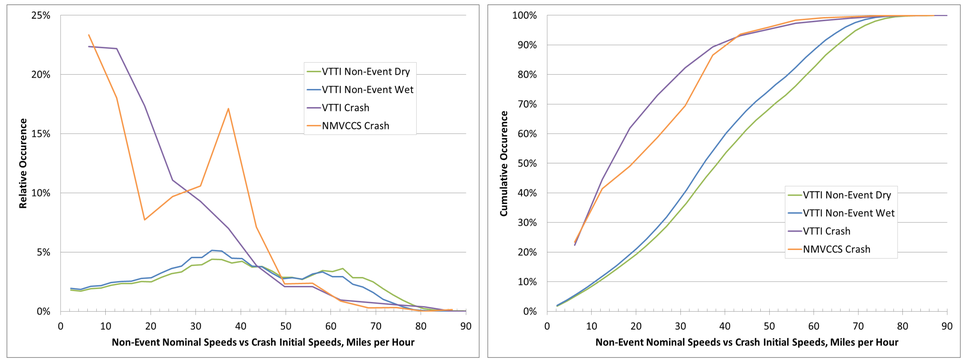


Outputs Relative Accident Risk for a Test Case vs a Nominal Reference Case

The reference case is based on data available in the market and attempts to represent the US public road situation. A test case can be developed by adjusting any of these distributions to meet a desired study case scenario.

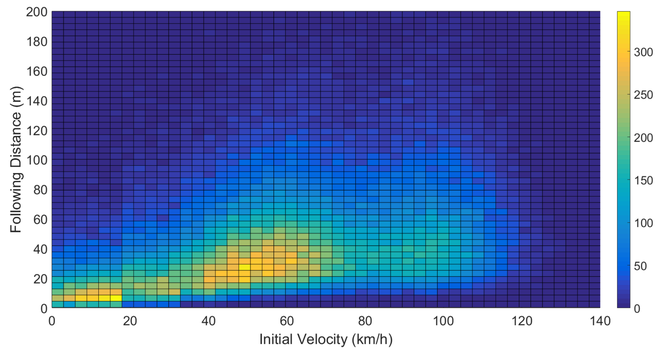
Elements Improved by VTTI NDS DATA

Non-Event Nominal Speeds and Crash Initial Speeds



Velocity distributions are compared between wet and dry conditions and between normal "non-event" driving and crash events. This data is then compared to the crash data from NHTSA's NMVCCS database. The model is simulating a wet braking scenario, so the wet non-event speed distribution was used.

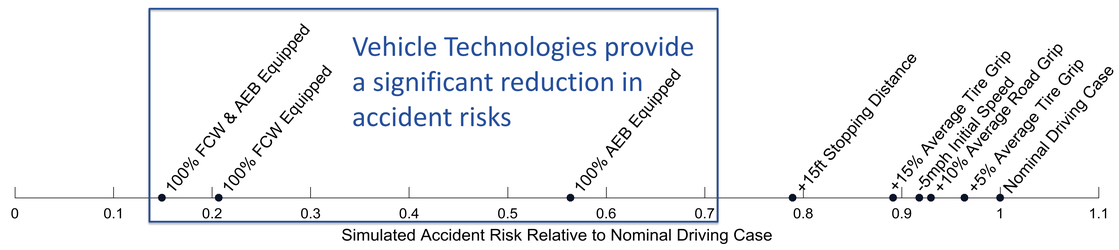
Speed Relevant Following Distances



Based on a bivariate distribution for following distance and velocity, a representative distribution of following distances can be found for a selected velocity.

Results

Nominal Case Without Vehicle Technologies (Yesterday)

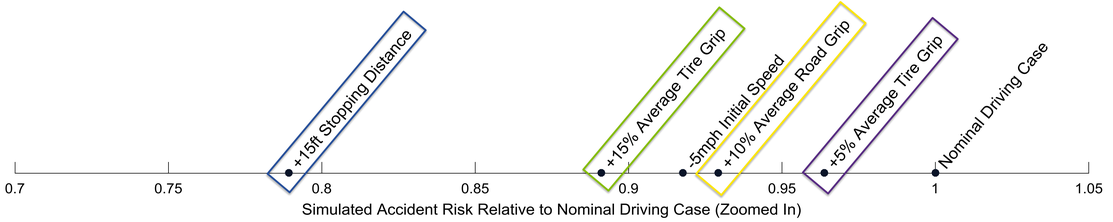


Vehicle Technologies provide a significant reduction in accident risks

+5%Tire Grip = -4% Relative Risk
+15% Tire Grip = -11% Relative Risk
+15ft Following Distance = -21% Relative

Most Influential Parameters
Vehicle Technologies
Driver Following Distance

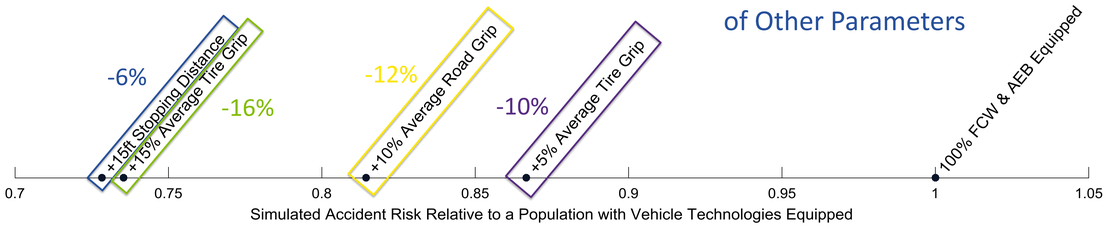
Comparing Nominal Case to Case With Vehicle Technologies 100% Equipped (Tomorrow)



+5%Tire Grip = -14% Relative Risk ★
+15% Tire Grip = -26% Relative Risk ★
+15ft Following Distance = -27% Relative ★

Most Influential Parameters
Driver Following Distance
New Tire Technologies

Increasing Influence = Decreasing Relative Risk



Vehicle Technologies also Increase the Influence of Other Parameters

Conclusion

As the use of automated vehicle systems expands, so will the influence of tire grip performance levels on collision risks. It is more important than ever that consumers and auto manufacturers consider tire performance levels. Therefore, the tire industry should continue to focus on wet grip as a key performance related to safety and should strive to continue to improve tire performance.