The Science of Vehicle Dynamics—Handling, Braking, and Ride of Road and Race Cars
Massimo Guiggiani
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I was fairly excited (both boyhood- and engineering-wise) about the chance to review a book on engineering dynamics as applied to the design of road and race cars. The fact that it was written by Università di Pisa professor, Massimo Guiggiani, who teaches and rubs elbows with some of the best European automotive engineers made this review even more intriguing.

My boyhood excitement was dashed a bit with the disclaimer on the verso-preface telling me not to use the book as a guide to design, build or modify vehicles (my wife will be glad to hear that).

My engineering excitement was dashed with Chapter Two's incorrect explanation and illustration of how a tire carries a vertical load. Both the text and illustration have the shell structure of the tire supporting bending stresses normal to the shell surface and therefore, supporting the wheel rim load mainly from the bottom half of the tire. Although the sidewalls of the tire can support relatively small transverse bending moments, the majority of the load is carried by the membrane stresses (i.e. meridional, tangential and shear) lying within the shell surface and therefore, the tire supports the tire bead and wheel rim load mainly from its top half. Fortunately, the dynamical studies in the rest of the book do not appear to rely on this explanation of how forces and moments at the tire/road interface are translated to the wheel. Rather, the book uses the empirical "Magic Formula" based on tire response testing and the "Brush Model" which is relatively simple but not analogous to the actual function of a tire.

With that small discrepancy out of the way, the bulk of the book is a very thorough and painstakingly developed dynamic analysis of components, assemblies, vehicles, and their design to provide optimal handling, cornering, braking, comfort and road holding. Chapter Two introduces the empirical tire model. Chapter Three develops the whole vehicle model (kinematic, equilibrium and tire equations) and then explains how to modify the model to include complicating factors of suspensions, differentials and a third axle. The general vehicle model is simplified in Chapter Four to focus on braking performance. Chapter 5 discusses rigid body kinematics of cornering and determines to define good and poor turning. Chapter Six simplifies the general model to study handling and introduces the MAP method of graphing and judging the handling performance envelope of a vehicle. The chapter finishes with a study of transient handling behavior. Chapter 7 also studies handling performance, but for race cars. Chapter 8 simplifies the general model to study ride comfort/road holding and the proper selection of spring, damper and inerter (a linear flywheel device having a reaction force proportional to the relative acceleration between its attachment points). Chapter 9 modifies the general model to include the handling performance effects of vehicle roll and vehicle pitch. The book concludes with the development and modification of the Brush tire model in Chapter 10.

The topic organization and paragraph numbering within each chapter could use one more edit to improve the clarity of the analyses. Also, worked out, real life example applications of tire response data and the various vehicle models would be welcome.

All things considered, *The Science of Vehicle Dynamics* serves as a good textbook for automotive engineering students and a good reference for automotive engineers.

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