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OPTIMIZATION OF VEHICLE RIDE AND HANDLING

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ABSTRACT

For as long as the motor vehicle has enjoyed widespread use, there has been ongoing discussion in the vehicle design community regarding the compromise between ride and handling. In this context, ride refers to passenger comfort over rough driving surfaces, where handling refers to both directional stability and responsiveness to steering inputs. Frequently, design changes that improve one of ride or handling are detrimental to the other. Additionally, handling alone can also be considered a compromise, as directional stability often comes at the expense of responsiveness to steering inputs. The work of Olley on the development of the concept of "flat-ride" and the corresponding design guidelines has been very useful in providing fundamental tools for the prediction of ride quality, but these are now many decades old. This paper explores the application of modern computer-based optimization tools to this problem.

In this work, the metrics for vehicle ride and handling are produced using a multibody dynamics vehicle motion simulation, based on the equations of motion generator code EoM, developed by the University of Windsor Vehicle Dynamics and Control research group. The EoM software can automatically generate the equations of motion for complex three-dimensional multibody systems, and can easily reproduce the many fundamental vehicle models used for ride and handling seen in the literature. The paper explores the use of the NOMAD optimization software as a means of assessing the output from the vehicle model. The NOMAD software, developed by the GERAD research centre, implements the Mesh Adaptive Direct Search algorithm for so-called "blackbox" optimization, wherein the penalty function is often the output of a complex numerical simulation. It is targeted at systems where the penalty function is computationally costly to evaluate, and no derivative information is available. Both the EoM and and NOMAD software tools are accessible through the Julia programming language, although the NOMAD tool uses an interface to a C++ implementation.

The results show that the combination of modern optimization techniques and multibody dynamics provides a valuable tool for automotive design applications.