Dynamic Stability and Control of Tripped and Untripped Vehicle Rollover

Synthesis Lectures on Advances in Automotive Technology

Editor
Amir Khajepour, ***University of Waterloo***

The automotive industry has entered a transformational period that will see an unprecedented evolution in the technological capabilities of vehicles. Significant advances in new manufacturing techniques, low-cost sensors, high processing power, and ubiquitous real-time access to information mean that vehicles are rapidly changing and growing in complexity. These new technologies—including the inevitable evolution toward autonomous vehicles—will ultimately deliver substantial benefits to drivers, passengers, and the environment. Synthesis Lectures on Advances in Automotive Technology Series is intended to introduce such new transformational technologies in the automotive industry to its readers.

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Zhilin Jin, Bin Li, and Jingxuan Li
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ISBN: 978-3-031-00372-1 paperback
ISBN: 978-3-031-01500-7 ebook
ISBN: 978-3-031-00005-8 hardcover

DOI 10.1007/978-3-031-01500-7

A Publication in the Springer series
SYNTHESIS LECTURES ON ADVANCES IN AUTOMOTIVE TECHNOLOGY

Lecture #6
Series Editor: Amir Khajepour, *University of Waterloo*
Series ISSN
Print 2576-8107 Electronic 2576-8131

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Zhilin Jin
Nanjing University of Aeronautics & Astronautics

Bin Li
Aptiv PLC

Jingxuan Li
Nanjing University of Aeronautics & Astronautics

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ABSTRACT

Vehicle rollover accidents have been a serious safety problem for the last three decades. Although rollovers are a small percentage of all traffic accidents, they do account for a large proportion of severe and fatal injuries. Specifically, some large passenger vehicles, such as large vans, pickup trucks, and sport utility vehicles, are more prone to rollover accidents with a high center of gravity (CG) and narrow track width. Vehicle rollover accidents may be grouped into two categories: tripped and untripped rollovers. A tripped rollover commonly occurs when a vehicle skids and digs its tires into soft soil or hits a tripping mechanism such as a curb with a sufficiently large lateral velocity. On the other hand, the untripped rollover is induced by extreme maneuvers during critical driving situations, such as excessive speed during cornering, obstacle avoidance, and severe lane change maneuver. In these situations, the forces at the tire-road contact point are large enough to cause the vehicle to roll over. Furthermore, vehicle rollover may occur due to external disturbances such as side-wind and steering excitation. Therefore, it is necessary to investigate the dynamic stability and control of tripped and untripped vehicle rollover so as to avoid vehicle rollover accidents.

In this book, different dynamic models are used to describe the vehicle rollover under both untripped and special tripped situations. From the vehicle dynamics theory, rollover indices are deduced, and the dynamic stabilities of vehicle rollover are analyzed. In addition, some active control strategies are discussed to improve the anti-rollover performance of the vehicle.

KEYWORDS

vehicle rollover, dynamic stability, tripped rollover, rollover index, rollover warning, anti-roll control, active safety of vehicle

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