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# Study on Identification of Equivalent Torsional Rigidity for Two-wheeled Vehicle Suspension

**Ichiro Kageyama [*], Yukiyo Kuriyagawa[#], Tetsunori Haraguchi[†], Yuki Kobayashi[$]**

[*] Center for Automotive Research (NU-CAR)
College of Industrial Technology, Nihon Univ.
1-2-1 Izumi-cho, Narashino-shi, Chiba, Japan
e-mail: kageyama.ichiro@nihon-u.ac.jp

[#] Center for Automotive Research (NU-CAR)
College of Industrial Technology, Nihon Univ.
1-2-1 Izumi-cho, Narashino-shi, Chiba, Japan
e-mail: kuriyagawa.yukiyo@nihon-u.ac.jp

[†] Institutes of Innovation for Future Society,
Nagoya University
Furo-cho, Chikusa-ku, Nagoya Japan
e-mail: haraguchi@nagoya-u.jp

[$] College of Industrial Technology,
Nihon University
1-2-1 Izumi-cho, Narashino-shi, Chiba, Japan
e-mail: yukky-rt@nifty.com

## ABSTRACT

This paper deals with two-wheeled vehicle characteristics for steady state turning considering equivalent compliance of steering system and rear suspension. In order to clarify the dynamics of two-wheeled vehicle at turning, first, we measured serval tire characteristics for the test two-wheeled vehicle. Next, steady state turning experiments ware conducted using these tires to analyze the characteristics of the vehicle. The steer characteristics and side slip characteristics were derived in consideration of the tire characteristics. As a result, the experimental results and the analytical results were qualitatively consistent but differed quantitatively. From the difference, the camber torques, self-aligning torque, overturning moments, and gyroscopic moments were put in the theoretical model. As a result, the experimental results and the theoretical results were very close, but there was a slight difference. From these results, it is shown that the equivalent torsional compliance of the steering system and the rear suspension are derived from the relationship of the side slip angle. Finally, it is shown that we can describe expressing the characteristics of steady state turning quantitatively.

**Keywords:** Motorcycle, Tire characteristics, Steady state turning, Steer characteristics of Motorcycle, Compliance steer.

## 1 INTRODUCTION

A study on motion characteristics of motorcycles was conducted by Prof.Sharp et al [1][2][3]. These studies have shown three main modes (Capsize, Weave, Wobble) and have had a major impact on subsequent researchers for the safety of motorcycles. However, these oscillation modes are the problem in the relatively high-speed region such as 150 km / h or more, and the oscillation called "shimmy" (a kind of wobble mode) generated in the steering system occurs at around 80 km / h. However, due to the effect of tightening torque control of the steering shaft and with handle dampers, these are not generated in vehicles which are sufficiently maintenance. Therefore, for the riders, it seems that the steady-state characteristics (mainly the steer characteristics, the side slip characteristic, and so on), the phase, the input gain, etc. are important as the motion characteristics of the motorcycle at the ordinary running speed[3][5][6][7]. When analyzing the turning behavior of such a motorcycle, the camber force on both tires is the main centripetal force, and the cornering force is used to assist this, so the force mechanism is