

Studies on the dynamics and stability of motorcycle

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ABSTRACT

In this thesis, the dynamics and stabilities of no rider controlled motorcycle running in the straight line have been studied. Firstly, the motorcycle is described as a mathematical model. No longitudinal slip is considered as the constraint conditions. By using the Lagrange ' s equation for quasi-coordinates, the equations of motion of motorcycle are derived. Secondly, the stabilities of motorcycle is considered from the equations of motion. The eigenvalues show the stabilities and frequencies of oscillation of motorcycle. The oscillations of motion are grouped into two kinds. The first kind is called by in-plane mode and the second one is out-of-plane mode. The in-plane mode consists of pitch and bounce motion and concern with the rider comfort. The out-of-plane mode is important in motorcycle stabilities, which include the capsize mode, weave mode and wobble mode. The stabilities of motorcycle are studied in different conditions: constant speed conditions, driving conditions and braking conditions. The weave mode and the capsize mode are hardly affected in the driving and braking condition while the wobble mode is neglected in the driving condition and less stability in the braking condition. Finally, the effects of parameters design are considered: trail, position of centre gravity of rear part, steering damper coefficient, steering head angle. From these result, the parameter can be designed to improve the stabilities of motorcycle.

Keywords : Motorcycle Dynamics、 Multibody System、 Numerical Stability、 Lagrange Equation

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