THE THREE-DIMENSIONAL SIMULATION OF MOTORCYCLE DYNAMICS

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ABSTRACT

This thesis is to develop the motorcycle-rider equation of motion by using Lagrange equations with nine degrees of freedom including the position and orientation of front and real wheel, the fork steering angle and the rider ’s lean angle. The rolling constrains between ground and wheels are also considered in the dynamical equations of the motorcycle-rider system. We use the symbolical mathematic software MAPLE to derive the three-dimensional motorcycle-rider dynamical model, and then write program to solve the differential-algebra equations via FORTRAN code. The simulation studies are divided into two parts. The first part is on the steady state conditions. From the equations of motion, we solve the system equilibrium points, i.e. the cornering velocity in different rider ’s lean angles and steering angles in the motorcycle. It shows that when the lean angle and steering angle increase, the trace radius of motion will decrease. We verify the steady behavior in computer simulation. The second part is the stability study under side disturbance. We can find that by adding the steering torque and adjusting the rider ’s lean angle, the turn over behavior will be delayed effectively.

Keywords : Motorcycle ; Dynamics ; Lagrange equation ; Motorcycle handling ; Differential-algebra equation

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