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Direct Yaw-Moment Control Based on Fuzzy Logic of Four Wheel Drive Vehicle under the Cross Wind

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Abstract

A control algorithm based on fuzzy logic is proposed to improve the straight line stability of four wheel drive vehicle with hub motor. This paper establishes the combined vehicle model based on CarSim and MATLAB, and researches the influence of cross wind on four wheel drive vehicle of different wind angle, wind speed and vehicle velocity. Then, the direct yaw-moment control model based on fuzzy logic is established to improve the handling stability of vehicle under the cross wind. The results proves that velocity of vehicle make biggest difference to the influence on vehicle under the cross wind, and the DYC model can decline the amplitude of yaw rate and improve the straight line stability of vehicle well.

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keywords:Four Wheel Drive Vehicle; Cross Wind; Fuzzy Logic

1. INTRODUCTION

With the promotion of environmental protection and energy conservation, electric vehicles have become the world's future development of hot spots, and the four wheel drive vehicle has also been widely concerned with the potential as the ultimate form of the development of electric vehicles, has also been widely concerned. The four wheel drive vehicle, abandoned the traditional automobile clutch, transmission, a universal transmission device and reducer, and other mechanical device. Putting the motor on the wheel hub can drive the wheels directly. In this way, there is more space for batteries, auxiliary power unit or fuel cells, along with more cargo and passenger space[2].Moreover, the torque response of the permanent-magnet synchronous motor is about much faster than that of the engine.[3] Compared with the traditional ICEV and single motor drive electric vehicle, the four wheel drive vehicle has its advantages on active safety in the integration, layout of the chassis structure, energy saving and vehicle

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driving force control. But due to the control strategy is relatively complex, the four wheel drive vehicle was mainly in research and development stage.

Control strategy of straight line stability of four wheel drive vehicle is one of the focal points of the research methods, and crosswind and lateral force are the important factor affecting the straight driving stability.

2. THE ESTABLISHMENT OF VEHICLE MODEL

CarSim is a VDAS for parametric modeling to complete simulated analysis and the user does not need to define the various components of the vehicle specific structure and shape, they just need to set all parts inertia parameters and performance to define a complete vehicle model.

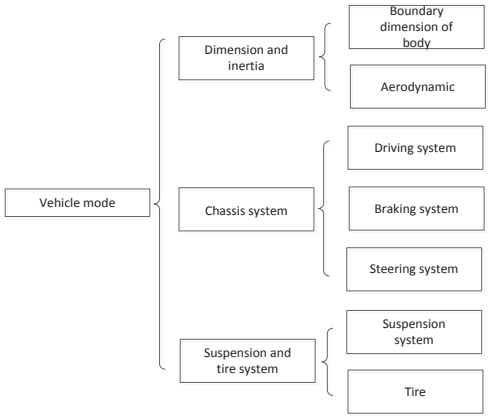

Fig. 1. (a) The structure of CarSim vehicle model

We can get the vehicle model when the parameters showed as table 1 is inputted into CarSim. Otherwise, because of the specificity of four wheel drive vehicle with hub motor, the sources of power in traditional power and transmission model should be cut down, and wheels will be directly connected with motor model in Simulink.

Table 1. Parameters of vehicle

Vehicle parameters	values
Vehicle weight (kg)	1160
Body size (mm)	4050/1600/1846
Distance from the center of gravity to the front axle (mm)	1040
Distance from the center of gravity to the front axle (mm)	1560
Tread (mm）	300
Tire radius (mm)	540
Height of center of mass (mm)	1846.4
Moment of inertia (kg*m2）	