International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 4 Issue 1 ǁ January. 2016 ǁ PP.11-16

Thesummaryabout fuzzy control parameters selectedbased on brake driver intention recognition

Pei Teng Zhao, HuanHuan Zhang, Xian Zhang Bian

Shanghai University Of Engineering Science

ABSTRACT: In this paper, the brake driving intention identification parameters based on the fuzzy controlare summarized and analyzed, the necessary parameters based on the fuzzy control of the brake driving intention recognition are found out, and I pointed out the commonly corrupt parameters, and through the relevant parameters ,I establish the corresponding driving intention model.

Keywords:fuzzy control,inference of intention,parameters,summary,model

I. INTRODUCTION

In the process of driving the vehicle, the driver's intention is to change with the surrounding environment and vehicle running state, so it is difficult to use an accurate mathematical model to describe, it is a typical empirical model, and the fuzzy theory has obvious advantages in dealing with empirical model. In the fuzzy recognition model of the driving intention of the automobile brake, the selected parameters are very important for the accuracy of the identification of the driving intention. In this paper, we analyzed the parameters used in the fuzzy control model of the brake driving intention.

II. PARAMETER ANALYSIS

The following is the parameters associated with the fuzzy identification model of the brake driving intention : the brake pedal displacement, the acceleration pedal displacement, the gradient of the acceleration pedal displacementgradient of the brake pedal displacement, the brake line oil pressure and the vehicle speed. These parameters can be obtained by the corresponding sensor.

I. THE BRAKE LINE OIL PRESSURE

The brake line is connected with the brake wheel cylinder, so the pressure of the brake pipe is a false impression of the wheel cylinder pressure. The factors that affect the accuracy of oil pressure signal in the brake line included: the free travel of the pedal, the air travel of the brake system, the friction of the pipeline, the wear condition of the brake pads. Therefore, the establishment of hydraulic brake line later than the establishment of the brake pedal displacement. If it is used as the input parameters of the driver's braking intention recognition, it will affect the real time performance of intention recognition. Therefore, this parameter should be carefully selected.

II.BRAKE PEDAL DISPLACEMENT AND BRAKE PEDAL FORCE

The displacement of the brake pedal is easy to control, and the brake pedal displacement signal can be obtained by means of the pedal displacement sensor, and the gap between the brake pedal displacement signal is small , so many researchers choose to use the brake pedal force as their research parameter .As when the pedal

force signal acquired, the pedal force sensor has a large gap, so the pedal force is not good to be controlled, and the real-time performance is not good, so the brake pedal displacement signal is usually used as the parameters of the driver's braking intention. Through the bench test, some research scholars take a multi group of brake displacement - brake oil pressure curve with different people used different pedal rate .as the following.

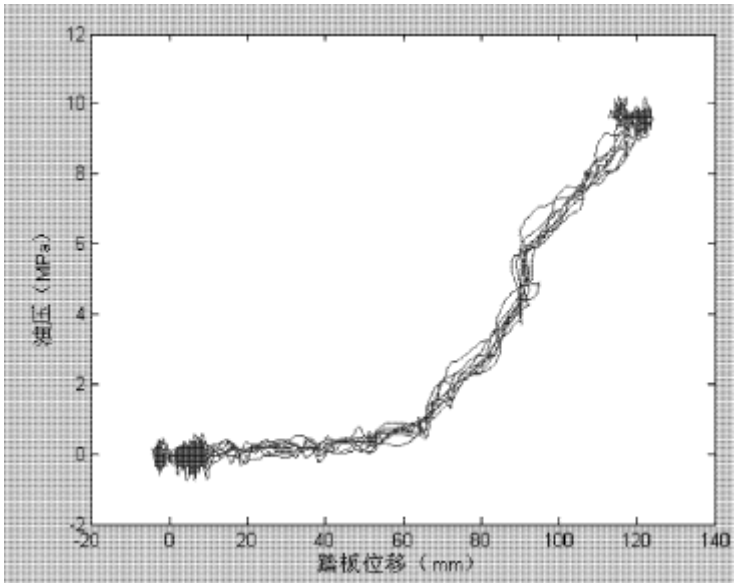

Figure 1 Pedal displacement - brake oil pressure curve

From the brake pedal displacement - brake oil pressure curve can be seen: the brake pressure of the vehicle and the pedal displacement has a relatively fixed relationship, because the brake braking force and brake pipe pressure meet the following relationship:

$$F = P\pi \sum_{i=1}^{4} u_i \frac{D_i^2 r_i}{2R_i}$$

$$z = \frac{F}{mg}$$

In the formula, irepresents the wheel, Drepresents the brake wheel cylinder diameter, Rrepresents the equivalent system power radius, Rrepresents the wheel diameter, μrepresents the friction pair, mrepresents the vehicle quality.

As a result, the brake strength Z can also be determined with the pedal displacement s.

Therefore, in the braking intention recognition model, the braking intention recognition parameters are the brake pedal displacement and the brake pedal displacement gradient. Such asin literature [9], Xu Ai Xiang establishes the model.Through the displacement of brake pedal and brake pedal displacement rate ,we can establish braking intention model: the fuzzy domain of brake pedal opening degree is [0,100], the unit as a percentage of the brake pedal travel, the fuzzy subset is [S, M, B], the brake pedal open gradient of the ambiguity domain is [0,300], unit for unit time opening percentage change, the fuzzy subset is [S,M,B] , braking intention characterization value is 1,2,3. The parameters of the membership functions are shown in figure 2~4.

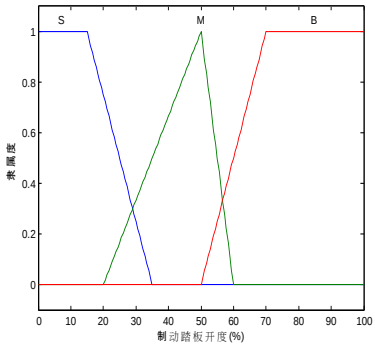

Figure 2 The opening of the brake pedal membership degree

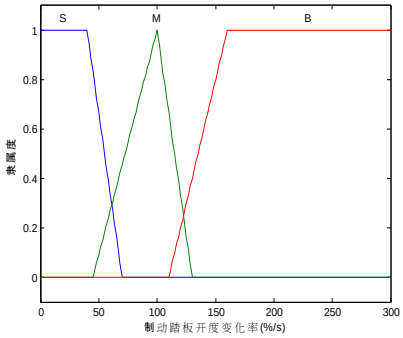

Figure 3 The brake pedal displacement rate of membership degree

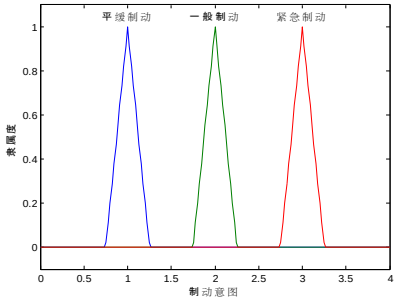

Figure 4 Braking intention of membership degree

The fuzzy reasoning rules as shown in Table 1.

Table 1fuzzy inference of braking intention rules

the opening gradient / The opening of the brake pedal	S	M	B
S	Smooth braking	Smooth braking	Smooth braking
M	The normal brake	The normal brake	Emergency braking
B	The normal brake	Emergency braking	Emergency braking

III. THE ACCELERATOR PEDAL DISPLACEMENT AND ACCELERATION PEDAL FORCE

Accelerating pedal force and brake pedal force with the same characteristicsthatthe control is not good and real-time performance is not strong. when the vehicle needs to stop, the driver needs to release the accelerator

pedal first, and then step down the brake pedal, but in the actual, driving process may also exist in the following two cases:(1) In some of the more urgent braking conditions, the driver may not release the accelerator pedal anddirectly depress the brake pedal.(2) Some pilots may be less skilled and at the same time step on the brake pedal and accelerator pedal. So it is very important to speed up the change of displacement and acceleration of the pedal. Therefore, it is one of the important parameters of the fuzzy recognition.

When the driver is braking, it is possible to step on the accelerator pedal, so it is necessary to build the model of the acceleration intention recognition. The parameters of the acceleration intention recognition model are the acceleration of the pedal displacement and the displacement of the pedal.Such as in literature [9], Xu Ai Xiang establishes the model.By accelerating pedal displacement and accelerator pedal displacement gradient can be established accelerated intention model, fuzzy identification algorithm takes the accelerator pedal opening and an accelerator pedal opening gradient as input, in which the acceleration pedal opening degree of ambiguity domain is [0,100], units for the accelerator pedal stroke percentage, the fuzzy subset is [S, M, B], the ambiguity domain of the accelerator pedal gradient is [-200,200], unit is unit time opening percentage change, the fuzzy subset is[N,S,MB], the accelerated intention characterization value is 4,5. The membership functions of the parameters are shown in figure 5~7.

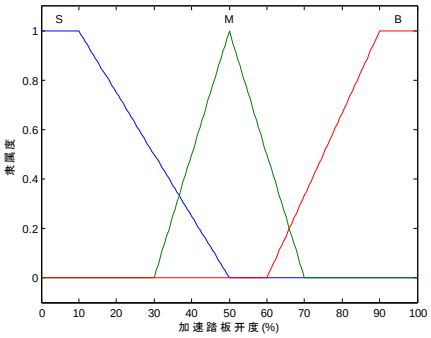

Figure 5 membership degree of accelerator pedal displacement

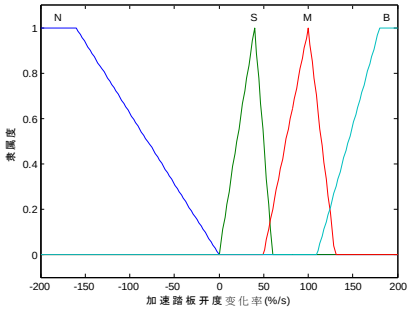

Figure 6 membership degree of accelerator pedal displacement rate

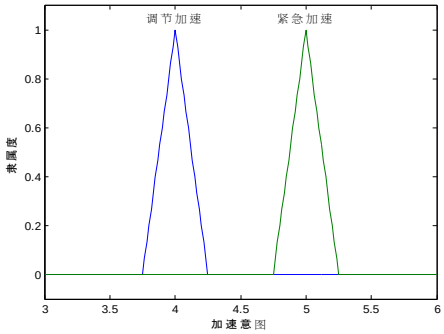

Figure 7 membership degreeofaccelerate the intention

Through the experience of the experts and the vehicle acceleration test data,we can obtain the speed of the different pedal state , We can deduce the fuzzy inference rules. As shown in Table 2.

Table 2 fuzzy inference rules of accelerating intention

Opening degree gradient / Accelerator pedal opening	N	S	M	B
S	Speedregulation	Speedregulation	Speed regulation	Speed regulation
M	Speed regulation	Speed regulation	Speed regulation	Emergency acceleration
B	Speed regulation	Speed regulation	Emergency acceleration	Emergency acceleration

III. SPEED OF A MOTOR VEHICLE

Vehicle speed reflects the current state of the vehicle, when the driver makes the brake operation, the size of the current speed also affects the safety of the brake, when the accelerator pedal and brake pedal are depressed at the same time, we also take into account the current speed, to measure the driver's brake intention.

IV. SUMMARY

If driver want to realizes the driving intention of the vehicle,first of all ,he should make the corresponding operation, such as stepping on the brake pedal, releasing the accelerator pedal. Secondly, the vehicle running state changes, that is, the intention of the driver is to realize, so the driver can take the vehicle parts of the operation as the identification parameters. Brake pedal displacement signal and the accelerator pedal position signal are the best parameter in model of driver's braking intention recognition because they have many good features .For example,they are easy to measured, stable characteristic, less influenced by the external environment,can more comprehensive reflect the driver's braking intention more comprehensive. The acceleration pedal displacement can reflect the driver whether release the accelerator pedal, and the gradient of the acceleration of the pedal displacement can reflect the emergency degree of the acceleration pedal, so they are also used as the parameter of driving intention. The driver's operation is closely related with the current running state of the vehicle, so the speed can reflect the driver's operation intention, so it is also one of the parameters of the driving intention recognition model. When adopt fuzzy control of the driving intention identification, you should select the aboveparametersrecommended.

References

[1] QiZhenMa.Research on braking energy recovery control algorithm based on braking intention recognition [D], Changchun: Jilin university, 2012.5

[2] Xin Gong. Research on the identification method of driver's braking intention based on fuzzy logic [D], Changchun: Jilin university, 2014.3

[3] Andrew Jackson, David Crolla, Adrian Woodhouse, et al. Improving Performance of a 6x6 Off-road Vehicle Through Individual Wheel Control. SAE paper 2002-01-0968.

[4] Remus Pusca, YoucefAit-Amirat, Alain Berthon et al. Modeling and Simulation of a Traction Control Algorithm for an Electric Vehicle with Four Separate Wheel Drives. IEEE 56th Vehicular Technology Conference, 2002(3):1671-1675.

[5] Russell P. Osborn, Taehyun Shim. Independent Control of All-Wheel-Drive Torque Distribution. SAE paper 2004-01-2052.

[6] XuanZhao, Jian Ma, Gui Ping Wang. Control strategy of hybrid braking control for pure electric passenger car based on the intention identification of brake [J].2014,14 (4): 64-75

[7] RenZhiLv.HEV control strategy based on state and driving intention recognition[D], Dalian: Dalian University of Technology, 2013.6

[8] Makoto Kamachi, Kevin Walters. A research of direct yaw-moment control on slippery road for in-wheel motor vehicle. The 22st International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition, Yokohama, 2006:2122-2133.

[9] Xu Ai Xiang.A brake control method based on the driver's braking intention recognitionChina,2015102365777[P].2015-8-12

[10] Chang Fu Zong , Chang Wang,Lei He ,etc.Double layer hidden Markov model based on driving intention identification [J]. Automotive engineering, 2011,8(33): 701-706.

[11] PongsathornRaksincharoensak, Takuya Mizushima and Masao Nagai. Direct yaw moment control system based on driver behaviourrecognition[J], Vehicle System Dynamics, 2008:911~921.

[12] JingJingMa.Study on identification of hidden Markov theory based on the driving intention [D], Changsha: Changsha University of Science and Technology, 2012.3

[13] Peng He, Yoichi Hori. Improvement of EV Maneuverability and Safety by Disturbance Observer Based Dynamic Force Distribution. The 22nd International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition. Yokohama, Japan, 2006:1818-1827.