A control method of an electric vehicle

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Abstract: The research of the electric vehicle in our laboratory is developed in two fields. One is the control of the speed (operation of the accelerator and the brake), the other is the controls of the steering wheel. We controlled the speed by using turning on and turning off control at the early stage. We could get a moderate result in this experiment. And we controlled the speed by the another control method that also had generality being possible to correspond to road situation. As a result, we could do the appropriate control of accelerator. Needing the control of the accelerator and the brake is combined with the control of steering wheel is running at a constant speed. This becomes a necessary, indispensable technology in doing the driving support and actually running on the road.

Keywords: operation of the accelerator and the brake, control method

1. INTRODUCTION

If the automatic driving technology based on "Active Safety" develops, the number of accidents by a human factor decreases. The control of the steering wheel by the image data processing using CCD camera was possible recent work. But control of an accelerator and a brake is not automatic. So in this system, combining the operation of the accelerator and the brake is a problem. Needing the control of the accelerator and the brake is combined with the control of steering wheel is running at a constant speed. Therefore, we research the speed control as a basic research to combine the control of the accelerator and the brake with the steering control by the visual system. We controlled the speed by using turning on and turning off control at the early stage of the research. We could get a moderate result in this experiment. But we controlled the speed by the PID control that also had generality being possible to correspond to more road situation.

2. ELCTRIC VHICLE

We shows this vehicle in Fig.1 and configurations of this vehicle in Table 1.

Fig. 1 An electric vehicle

Table 1 A configuration of an electric vehicle

Length	2,395(mm)
Wide	1,010(mm)
Height	1,490(mm)
Weight	470(kg)
Max speed	45(km/h)
Motor	DC brassieres motor
Max power	5.2(kw)

3. CHARACTERISTIC OF ACCELERATAOR AND BRAKE

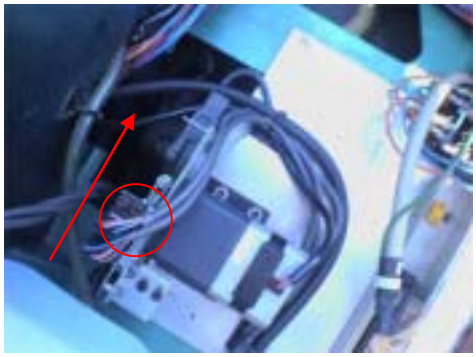

Fig.2 Motor of accelerator

The accelerator of the electric vehicle does a usual accelerator operation by rotating the motor. In an other word, the accelerator wire is pulled by depressing the accelerator when the driver person, and it leads to the drive of the DC motor.

Another wire is pulled by rotating, and the DC motor is driven the stepping motor the act of pulling the accelerator wire. Moreover, the brake ties to the stepping motor the brake pedal with the wire. They greatly depend on the parameter, the number of movement pulses, and the passing speed used to control the stepping motor, and control the amount of depressing of the accelerator brake and the depressed speed by changing these parameters.

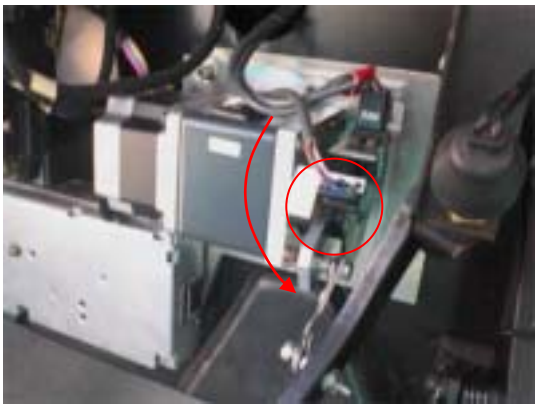

Fig.3 Motor of brake

Here, the moving speed is a parameter in the amount of depressing of the accelerator and the brake in the number of output pulses corresponding to each depressed speed. It is based on the specification of the stepping motor of the amount of the rotation in the number of pulses in this and the specification of the rotational speed at the pulse frequency.

4. Control method

We get speed characteristic of this vehicle from experiments and below equation.

Speed characteristic with load

$$y(k) = \frac{1.46}{751.2}(R(k) - R(k-1))(m/s)$$
$$= \frac{1.46 \cdot 3.6}{751.2}(R(k) - R(k-1))(km/h) \quad (1)$$

here: sampling time 1(sec)

The difference of the encoder value is taken in this computational method, and the speed is calculated by the change.

We do experiments use this equation. And control method is using simple PID control. At first, we do a constant moving speed experiments. It is for the characteristic of this vehicle moving speed. It runs in the straight line by using a general road as the experiment method. It is set that the measurement time is assumed to be 60(sec), and the stop operation is done after it runs of 40(sec). The accelerator and the brake operation between those are due to the program, and the experimenter (driver) does the steering wheel operation.

The expression from which the number of movement pulses is:

$$u(k) = 33.657\left\{e(k) + 1 \cdot \sum_{j=k-1}^{k} e(j) + 1 \cdot (e(k) - e(k-1))\right\} \quad (2)$$

$$e(k) = r(k) - y(k) \quad (3)$$

u(k) : number of moving pulse
e(k) : difference
y(k) : speed value

One of the experiment result is presents Fig. 4. It is understood that the shifting value at the speed that is the problem in the current result is considerably improved from the experiment result. Moreover, it becomes a repetition of a detailed error margin about other shifting value parts, and the more error has disappeared. It became the result of understanding number of the accelerator increased in shape corresponding to this about number of the accelerator in the inclination of going up. However, there is an insufficient part as a control of the speed.

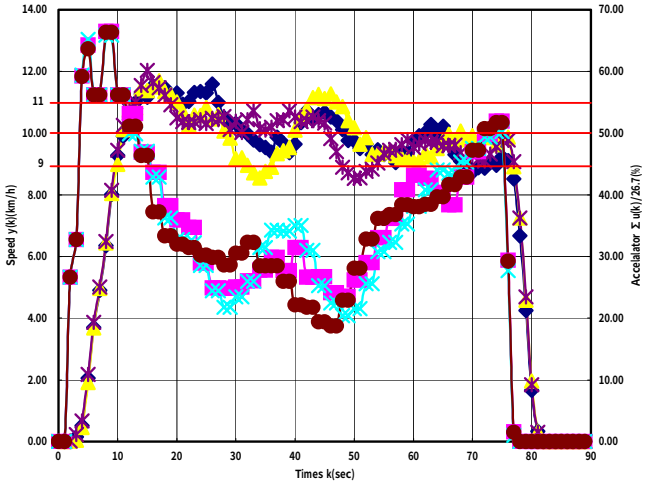

Fig.4 Speed chara. using PID control

5. CONCLUSION

In this research, first of all, the base of the speed control was done. Next, the speed by PID was controlled. Various parameters in the PID control were decided from the experiment. However, the characteristic was led by using the speed characteristic of not a real load but no-load-condition that the speed settled to some degree. The adjustment of each parameter has properly adjusted a necessary part repeating the experiment. One of the results was shown. However, it is thought that the problem by the delay of the processing speed occurs in both the steering control, the accelerator, and the brake control by increasing the speed.

It is necessary to examine the combination with the steering control as a problem in the future with the improvement at the parameter and the sampling time.