A Study on PID Gain Auto Tuning for Steering Type Mobile Robot

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ABSTRACT - In this paper, we propose PID gain auto tuning method for steering control of mobile robot. The gain is obtained by the method of Ziegler-Nichols. We were applied to the mobile robot with the obtained gain. And the new gain is calculated by the second transfer function. We were performed the experiments on the response time and the holding error rate with the obtained new gain and were confirmed performance in respect of PID auto tuning.

Keywords: PID control gain, Auto tuning, Steering PID control, Steering mobile robot

1. INTRODUCTION

Steering devices for turning directions in wheeled mobile robots are mechanical method that have been used for a long time. To control this electronically, a controller is required[1]. The electronic steering system consists of a position input device for checking the steering position and a motor output device, and that has been proposed in various ways[2]. Among the various methods, PID controller using proportional, integral, and derivative has been used for a long time because of its excellent performance and stability. PID gain can be set manually or automatically[3]. In this paper, we were proposed an automatic gain setting method and a time reduction method, and it was verified through experiments.

2. The steering PID

The PID controller use with input the error of the present value and the target value. The first, proportional gain greatly affects the output when the magnitude of the error increases. However, proportional control can not respond to small errors. Differential control and integral control are necessary to overcome this problem. The second, The integral gain responds to the cumulative error and the cumulative error is used for errors such as deviations with no directional variation. Finally, the differential gain reacts to overshoot or undershoot.

![Figure 2. PID Controller](image-url)
3. Auto tuning

In this paper, the gain setting method used is to measure the change of the target value and the present value for the increase by using the stepped response curve[4]. The step response curve for the initial response delay time($L$), time constant($T$), and gain($K$) is shown in Fig 3.

![Figure 3. Step response](image)

4. Experiment & Performance evaluation

We were measured auto tuning time by applied to the system on calculated gain. In result, It took about 39 seconds for the automatic tuning.

<table>
<thead>
<tr>
<th>Number</th>
<th>Time(second)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>41.97</td>
</tr>
<tr>
<td>2</td>
<td>36.44</td>
</tr>
<tr>
<td>3</td>
<td>38.25</td>
</tr>
</tbody>
</table>

Table 4. Auto tuning time

We performed test set to two states the target position of the mobile robot steering system. The first conditions used from 0 ° to the -30 ° and the second conditions used from 0 ° to +30 °. Items for measuring the controller performance are convergence time, overshoot, undershoot, and sustain error.

![Figure 4. Perfomance characteristic(0° - 30°)](image)

REFERENCES