ANGULAR VELOCITY METER APPLICATION STUDY IN THE AGRICULTURAL VEHICLE NAVIGATION SYSTEM

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ABSTRACT

In the agricultural vehicle navigation system, most frequently used steering feedback sensors, such as rotary potentiometer, rotary encoder and linear potentiometer, are usually installed a miniature troublesomely, and often have relatively low reliability because of the more installation fittings. With the progress of MEMS technical, angular velocity meter achieves higher accuracy while the cost is lowered to a quite low level. Due to the simple installation, high reliability, the angular velocity meter is used more widely in the agricultural vehicle navigation system. In the steering control system which adopted angular velocity meter, if we use steering angle which was simply integrated of the angular velocity as the feedback of the steering algorithm, the control accuracy will be significantly decreased with the passage of time. This article studies with an angular velocity meter which attached on the top of the kingpin of a tractor. A double-loop PID steering control algorithm was proposed here. Based on tractor steering control, contrast to single loop PID steering control algorithm, a comparative test was made. The comparison indicates that the algorithm this article proposed has a higher precision.

Keywords: Angular velocity meter, steering control, automatic guidance, cascade control

INTRODUCTION

Steering control is an important aspect of agricultural machinery navigation control system its control precision directly affects the accuracy of path tracking. In traditional steering control system, people usually use a rotary encoder to measure kingpin rotation angle, or utilize a linear potentiometer to measure the telescopic length of steering cylinder. But the reliability of the steering angle measurement is generally lower, due to the installation. This article studies with the method of an angular velocity meter used in a steering control system. A double loop PID steering control algorithm is proposed, which reduces the steering control error caused by the MEMS random error.

MATERIAL AND METHOD

The MEMS angular velocity meter attaches on the top of the kingpin of the Lovol TA800 tractor, and its body is parallel with the plane of the tractor body. The tractor uses hydraulic proportional valve to achieve automatic steering control. The steering controller adopts cascade structure, the set value and feedback value of the inner loop is angular velocity, the set value and feedback value of the outer loop is steering angle. Both loop use PID algorithm.

RESULTS AND DISCUSSIONS

The inner loop improves the steering velocity response, and the overall double loop steering control algorithm improves the measuring precision. Based on tractor steering control, contrast to single loop PID steering control algorithm, a group of comparative experiment was taken. Steering control accuracy is improved from 1.1°to 0.6°, and the adjusting time is improved from 0.7s to 0.5s at the set value of 10°.

CONCLUSION

The comparison indicates that the double loop PID steering control algorithm this article proposed has a higher accuracy contrast to the traditional single loop PID steering control algorithm. This method effectively improves the steering control accuracy in the case of using MEMS angular velocity meter as the feedback sensor.