Development of a Leader-follower System for Farm Use

環境資源学専攻　生物生産工学講座　ビークルロボティクス研究室　Zhang Chi

1. Introduction

The objective of this study was to find a solution to make good use of two tractors at the same time. Firstly, a human-driven tractor followed a robot tractor and doing agriculture work. Secondly, to reduce the working strength of a human operator, leader-follower system between two robot tractors was brought up. A robot tractor followed the other robot tractor and doing fieldwork at the same time. In the second case, human could just sit in the latter robot and monitor the two robot tractors.

2. Method

Fig.1 shows the robot tractor followed by a human-driven tractor system. A GPS and an IMU were used to measure the position and heading angle. U-turning method, remote controller, video transmission system were used in this system.

The robot tractor followed by a human-driven tractor system helps to improve the working efficiency. However, it increases the working strength of the human operator. In this case, a leader-follower system between two robot tractors can solve the problem as shown in Fig. 2. In order to accomplish the leader-follower system, two robot tractors were firstly developed. Secondly, communication system between the robot tractors was developed. Linear method, quadratic method, cubic method, and improved quadratic method were proposed to control the velocity of follower robot.
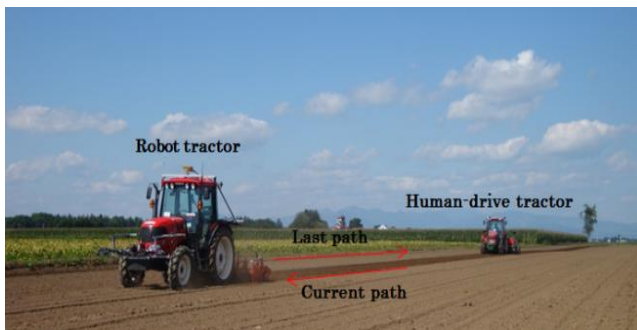

Fig.1 Robot followed by a human-driven tractor system   Fig.2 Leader-follower System

3. Experiment results

The average lateral error of the robot tractor was -0.3 *cm*, and the RMS of lateral error was 3.0 *cm*, which was an acceptable value. The total time delay of remote controller was about 2.0 *s*. The velocity of the robot was 1.0 *m/s*, and the stopping distance was 0.98 *m*, which was a safe distance.

The leader-follower system experiment results show that the steady state error improved from -21 *cm* to -5 *cm* by using the improved quadratic method.

4. Research summary

This research developed two systems for farm use. First one was robot tractor followed by a human-driven tractor system, and the second one was leader-follower system between two robot tractors.