Development of an Agricultural Implement Guidance System

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Introduction

Agricultural machinery automatic navigation technology is an important part of precision agriculture. In order to achieve accurate mechanical inter-rows weeding and agricultural vehicle navigation, an integrated navigation system of agricultural vehicle and implement based on GNSS and MV were designed. The system can reduce labor intensity, upgrade working accuracy, and improve the safety of operators. The system is a convenient, efficient and automatic agricultural implement guidance system, and easy to realize large-scale production.

Methods

The integrated guidance system is divided into three sections: mechanical structure design, controller design and software development. The working principle of the system as shown in Fig.1. Fig.2 is the components of the system.
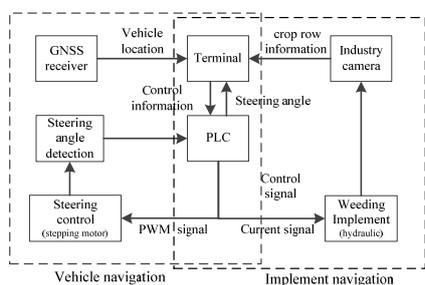

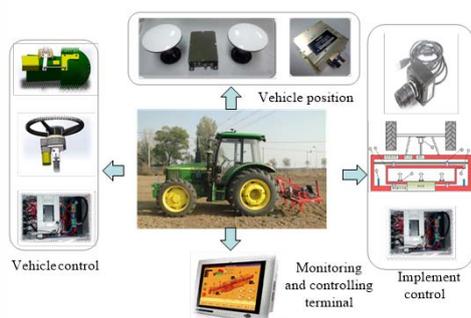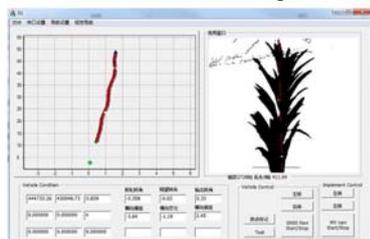Fig. 1 The working principle of the integrated guidance system

Fig. 2 The components of the system

The software was designed and developed to collect and process the GNSS and image data.

Development environment：
Visual Studio 2010, MFC/C++

Fig. 3 The interface of the software

Experiment and Discussion

MV is used for the implement guidance. A linear scanning algorithm is proposed to identify crop lines. Figure 4 shows the guidance line detection result by linear scanning algorithm

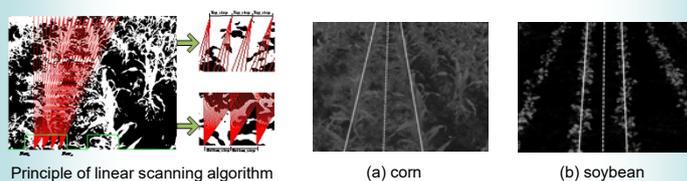Principle of linear scanning algorithm　　(a) corn　　(b) soybean

Fig. 4 Image processing algorithms of agricultural implement guidance system

The experiment was designed to compare the performance of the vehicle navigation system and the integrated navigation system. The distance of each navigation operation is 50 meters, and the weeding error is as follows:

ID	Max. Error/cm		Ave. Error/cm		SD/cm	
	VNS	INS	VNS	INS	VNS	INS
1	10.70	6.92	3.91	2.77	4.90	3.70
2	9.39	6.85	3.78	2.40	4.82	3.01
3	9.46	4.67	3.19	1.74	4.07	2.19
Mean value	9.85	6.15	3.63	2.30	4.60	2.96

* VNS-Vehicle Navigation System, INS-Integrated Navigation System

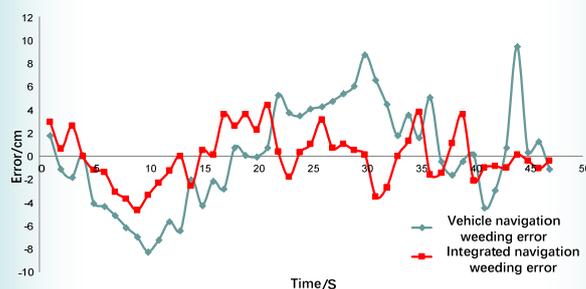Fig. 5 Experiment of integrated navigation system

The performance of the integrated navigation system is better than the vehicle navigation system.

Conclusions and Acknowledgements

1. An integrated navigation system of agricultural vehicle and implement based on GNSS and MV were designed.
2. The image processing algorithms of the navigation system were built to improve the accuracy of mechanical agricultural vehicle and navigation inter-rows weeding.
3.