Mathematical and Computer Modelling 54 (2011) 1145–1150

Contents lists available at ScienceDirect

Mathematical and Computer Modelling

journal homepage: www.elsevier.com/locate/mcm

# Orchard tree structure digital test system and its application

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ARTICLE INFO

*Article history:*
Received 20 August 2010
Accepted 4 November 2010

*Keywords:*
Digital test system
Tree structure
Ultrasonic sensor
Serial communication

ABSTRACT

Tree structure probing is a significant basic part of target precision spraying. Orchard tree structure digital test system, which consists of three components, is designed by using the ultrasonic sensors. The conveying platform is for fixing and precisely moving the sensor which is used for probing the tree profile. The lower computer can process the test data and communicate with upper computer. The upper computer can record data into Access database and show the results to the users at the same time. Utilizing the orchard tree structure digital test system, a Hawthorn tree structure is calculated. The experiment shows that probing accuracy is not less than 87%.



## 1. Introduction

Precision spraying plays an important role in precision agriculture. For orchard trees, target spraying is the base of precision spraying [1–3]. The existence of trees can be determined by image recognition, laser detection or infrared technologies. On the basis of tree's position, pesticide is sprayed to the tree rather than to the gap of trees, thus reducing the environmental pollution [4,5]. But its limit in probing trees' structure on-line leads to its shortage in accurately calculating the amount of pesticides required in different parts of the tree. Ultrasonic sensing is a technology that has the potential for non-destructive crop canopy characterization [6–8]. In fact, this technology has been introduced in the past in agricultural applications because of its advantage in high accuracy of distance measurement. In theory, the sensor, which will transmit a burst of high-frequency sound, can compute the distance based upon the speed of the sound and the elapsed time between sound transmission and echo return [9].

The objective of this research was to develop an orchard tree structure digital test system under ultrasonic sensing technology. This new system was also applied to test Hawthorn tree structure.

## 2. Materials and methods

### 2.1. Digital test system

An orchard tree structure digital test system, which includes a conveying platform, lower computer and upper computer, is developed mainly by applying an ultrasonic sensor (Fig. 1).

The conveying platform contains a guide, a slider and an aluminum bar. In the guide there is a step motor which can precisely move the slider along the guide. The bar is vertical to the ground, which is used to fix the sensor.

The lower computer consists of a circuit board, motor driver and current voltage converter. As the core unit of the lower computer, the circuit board can not only read sensor data, process the data, and send the result to the upper computer, but

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0895-7177/$ – see front matter © 2011 Published by Elsevier Ltd
doi:10.1016/j.mcm.2010.11.047