基于超声波传感器和DGPS的果树冠径检测

Performance of tree canopy diameter measurement based on ultrasonic sensor and DGPS

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中文关键词：超声波传感器； 差分全球卫星定位系统(DGPS)； 果园； 冠径； 检测

英文关键词：ultrasonic sensor; differential global position system; orchard; tree canopy; measurement

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中文摘要：

为实现果园果树的仿形精确喷雾，适时获取果树冠径信息，采用超声波传感器，GPS接受机和电子罗盘等在拖拉机上建立了一套果树冠径检测试验系统。并在室外对5个圆柱规则外形树冠进行了检测试验。试验分别采用4种树冠直径检测计算方法，并选择0.31 m/s和0.65 m/s两种不同拖拉机行驶速度进行检测。采用误差分析的方法检验果树冠径检测系统的实际检测效果。误差分析表明拖拉机分别以0.31 m/s和0.65 m/s速度行驶时，应用超声波探测果树树冠两个轮廓边缘计算5个树冠直径的平均相对误差分别为5.54%和5.80%。用电子罗盘和DGPS数据进行加权平均融合修正拖拉机行驶轨迹，由超声波检测到的果树两个轮廓边缘的位置信息计算果树直径，在两种检测速度下的平均相对误差为14.38%。研究结果为果树仿行喷雾控制和果园果树生长信息采集提供了技术方法。

英文摘要：

To carry out precision spray based on fruit tree canopy and to obtain real-time tree canopy diameter in orchard, a measuring system for fruit tree canopy diameter was established on the tractor by using data-collecting facilities such as ultrasonic sensor, DGPS receiver, and electronic compass. Outdoor measurement experiment was conducted on five trees with regular cylinder-shaped canopy. Four calculation methods were introduced for the measurement of tree canopy diameter. Tractor traveling speeds of 0.31 m/s and 0.65 m/s were selected to measure and to examine this measuring system. Error analysis results show that the mean relative errors are 5.54% and 5.80% in computing the canopy diameter between two outer rims using ultrasonic sensor while the tractor is traveling at 0.31 m/s and 0.65 m/s, respectively. After the weighted average fusion of using ultrasonic sensor and DGPS data, the tractor track was corrected and the mean relative error for the two traveling speeds is 14.3% when measured with calculating method using the coordinates obtained by measuring the two outline rim points on tree canopy. The research results provide methods for the control of fruit tree profile spray and collecting information on fruit tree growth.

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