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Crop-row detection algorithm based on Random Hough Transformation

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ABSTRACT

It is important to detect crop rows accurately for field navigation. In order to spray on line, a variable rate spray system should detect the crop center line accurately. Most existing detection algorithms are slow to detect crop rows because of the complicated calculation. The gradient-based Random Hough Transform algorithm could improve the calculation speed and reduce the computation effectively by the more-to-one merger mapping method. In order to detect the center of the crop row rapidly and effectively, the detection algorithm with gradient-based Random Hough Transform was proposed to detect the center line of crop rows. We tested the center line of crop-row detection for three kinds of plant distribution, being sparse, general and intensive. The experimental results showed that the detection algorithm with gradient-based Random Hough Transform was adaptive to the difference of plant density in the crop row effectively. Contrasted with the detection algorithm based on the Hough transform, the detection algorithm based on the gradient-based Random Hough was faster and had a high detection correction rate.

0. Introduction

Variable rate spray systems based on machine vision are important to reduce the amount of chemical pesticide and protect the environment. Research for real-time and environmentally adaptive plant locations is crucial to a variable rate spray system. The center line of the crop row should be detected to ensure spraying on-row and for vehicle navigation. The center line of the crop row is mainly detected by an algorithm based on the Hough transform [1–5] or projection [6–9]. The Hough transform algorithm is used widely in line detection for its high robustness. The Hough transform was first proposed by Marchant et al. [1] to detect the crop center line. The experimental results showed the crop center line could be detected effectively by the Hough transform. The crop navigation baseline detection algorithm was proposed to combine the Hough transform with mass analysis [3]. The algorithm was tested and verified in the soybean field. The experimental result indicated that the algorithm could overcome the impact of shadows. The adaptive Hough transform algorithm was proposed to detect ripe lettuce rows [4]. Experiments showed that the algorithm was efficient for the shadows and irregular noise. However, this algorithm could not extract the crop row line correctly when there were gaps in the crop row. The crop row line detection algorithm based on projection [7] was put forward. The field crop image was segmented into several equal parts first, and then projected in the vertical direction to calculate the barycenters of the crop in every part. The barycenters were connected with a linear regression method, and then the crop center line was obtained. A method based on vertical projection was described [8]. Firstly, the row crop and background were segmented by the excess green value. Secondly, the image trips were divided by the crop image horizontally and the position was calculated by detecting the peak on the curve resulting from vertical projection of the trips. Finally, the crop rows center lines were established by robust regression. The experimental results of soybean images confirmed the effectiveness of this method.

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