Autonomous UGV-based weed detection system for vineyards

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Abstract

In the last years, the use of robotics technology in agriculture is constantly increasing. Robotic platforms are the application of automation and robotics in agriculture field to relieve manual and heavy tasks from workers. These devices have already started to transform many aspects of agriculture and are hesitantly finding their way to the market. Therefore, robotic solutions which can provide alternative routes to weed management may provide a transformational enabling technology to mitigate against biotic and abiotic stresses on crop production, for example automatic weeding robots are the preferable substitute for chemical herbicide to remove weeds. One of the most impacting abiotic factors in agriculture are weeds, causing important yield loss in every cultivation. Integrated weed management coupled with the use of robotic platforms (UGVs), allows the effectively weed management, us a beneficial methodology for the environment. The detection of weed spots in a cultivation can be achieved by combining image acquisition by UGV and further processing by specific algorithms. These algorithms can be used to weeds control by autonomous robotic systems via mechanical procedures or herbicide spray.

The weed management is one of the major challenges in viticulture, as long as weeds can cause significant yield losses and severe competition to vines. One of the cheapest and effectiveness method remains the weed control with chemicals; however, several adverse effects and risks may arise. Different methods like tillage, thermal method, mulching and cover crops can be included in weed control strategy, depending on the environmental conditions, soil and crop. As it is known, the mechanical methods are the most cost-effective weed management methods in vineyards.

Monitoring weed in different vineyards will provide a useful database for understanding the weed management practices. In this direction, this paper presents a system for a weeding detection robot. The objective is to be enabling the weed detection robot to navigate autonomously between the inter-row spaces of crop for automatic weed control, reduce labor cost and time. In this paper, various of image processing techniques with the implementation of an RGB-D camera was examined in order to: i) detect the path between two rows of vineyard and ii) allocate the weeds based on various a priori characteristics. As a pre-processing state, the real time data from the RGB-D camera transformed into different color spaces in order to denote the noise that could occur. Subsequently, the examined algorithms and techniques tested in numerous of aggregated data from real vineyards with different levels of weed development. Finally, the developed algorithm tested by implementing it on a UGV platform with promising results.

Key words: weed detection, vineyard, RGB-D camera, UGV, surface registration.

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