

DETERMINATION OF THE DENSITY OF APPLE TREE CROWN USING AN EQUIPMENT FOR DIGITAL IMAGE ACQUISITION

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Abstract

Keywords: spray map, precision spraying, stereovision camera, mobile platform, precision orcharding, vision system, image analysis, integral plant protection.

The problem while spraying fruit trees with plant protection products, is to properly select the amount of spray liquid in accordance with the size of the tree and the phenological phase of the plants. This is due to the fact that fruit trees vary in the density of the crown. During intensive growth, fruit trees change the volume and density of their crowns very quickly. Adjusting the appropriate dose of the working liquid to these tree features, in the subsequent development stages of plants, has a significant impact on the precision of application and uniformity of liquid distribution in the crowns. The system analyzing the condition of trees, that allowing each tree to be treated individually as well as to apply a plant protection product according to the individual needs of each tree, would implement the idea of the variable dosing technique - VRA.

The aim of this study was to develop a mobile system that allows an efficient analysis of the crown density of apple trees growing in the orchard. It turns out that any orchard machine can be equipped with such a system, which has a stereovision camera and a digital system that allows for a detailed analysis.

The need to implement precise application methods resulting from the current conditions of orchard production, dictated by the requirements of integrated pest management, the pesticides directive, consumer requirements (zero residues) and maintaining high environmental standards in the era of agricultural hazards, such as e.g. surface water pollution. Necessitates the development of an innovative system to reduce losses in plant protection products.

The use of innovative computer technologies that support mechanical engineering

in the application of image prediction facilitates individual analysis of particular trees in the orchard. For this purpose, a mobile platform, equipped with appropriate research equipment enabling the analysis of the density of apple tree crowns in real time was created. There is a problem with how to isolate the foreground trees in the image recorded while driving through the orchard, overlapping the image of trees in further rows. The solution may be to use a stereovision camera, which provides the solutions, thanks to which the elimination of the background and the extraction of foreground objects will be possible.

The application of the discussed system enables automatic detection of voids in the stand. Spray losses during the turning maneuvers between the aisles have been reduced. The possibilities of the method are universal after appropriate calibration. The system can be used in other plantations and types of production. The use of plant protection products is common. Any savings associated with work during the spraying treatment will improve the quality of the final product. One of the problems that has been left to analyze is the mechanical response speed of the sprayer. The analysis of trees in the orchard is carried out in real time. The time needed to obtain the information is less than 1 second for one image frame.

The obtained results clearly show that the type of apple variety has no influence on the stability of the system operation. Regardless of the variety, the system enables the detection of voids between tree crowns. The conducted research has shown that the assumptions related to the use of a stereovision camera for the analysis of tree crown density in an orchard are justified. The three-dimensional image of the tree's crown allows you to increase the precision of spraying for each object in a spray field defined by the sprayer operator. The performance of the vision system depends on the type of equipment used to analyze the image obtained from the camera. In addition, the possibility of obtaining a spray map allows for the use of this system in precision fruit farming. The advantage of the system is the reduction of the disadvantageous drift of the active agent outside the spray zone. During the analysis of material from reference runs and later with the settings of automatic detection of space between trees in the Osiris program, the time of opening and closing the nozzles differed significantly. The total time of opening the nozzles without the use of the system (continuous spraying) and with the use of the analyzer differed in the initial stages of vegetation at the level of 75%.