Design of a field robot to detect olive trees infected with Xylella fastidiosa using remote sensing techniques

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A small electric robot has been designed and built to transport different computer vision equipment that allows the monitoring of an entire field of olive trees in search of an early infection by Xylella fastidiosa. The robot uses two batteries to power two electric motors attached to the wheels, which last more than six hours, which allows a complete inspection of a field of approximately 4 ha. It is driven by remote control. Due to the height of the trees, a system of elevation of the cameras has been designed so that they can rise up to 200 cm. A programmable system has been developed to synchronise the cameras with the advance of the vehicle, allowing to adjust the spatial distance at which each image is acquired. An encoder connected to the axis of one of the motors determines the distance travelled by the vehicle allowing the computer to trigger the cameras. A series of tests have been carried out in an olive orchard showing slight symptoms of Xf infection in the region of Apulia, southern Italy.

The robot was deployed in the test field equipped with a digital SLR camera, another digital SLR camera modified to capture blue NDVI images and a multispectral camera capable of acquiring eight wavelengths and a bandpass image in the region of 550 to 850 nm. The system was programmed to capture an image for each meter of the robot's advance. In addition, a 2D laser scanner (LIDAR) was used to capture a cloud of points of the orchard in order to obtain the 3D structure of the trees and estimate the leaf area index (LAI). During the first tests, the robot covered the whole crop twice, obtaining images and data with all the sensors in different atmospheric conditions (from intense sun to intense rain). The vehicle advanced in each row acquiring the images of the trees on one side and returning in the same row acquiring the images of the trees on the other side. The first test allowed to adjust the electronics, the programming and all the sensors, as well as improving some aspects in the robot in terms of autonomy and ease of handling. The sensors worked correctly and the data are serving to create different spectral maps that will be compared with visual observation and molecular analyses of the leaves of the trees to confirm the presence of the bacteria.

Keywords: Robotics, computer vision, multispectral imaging, Lidar, asymptomatic detection

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