Detection method of obstacle for plant protection UAV based on structured light vision

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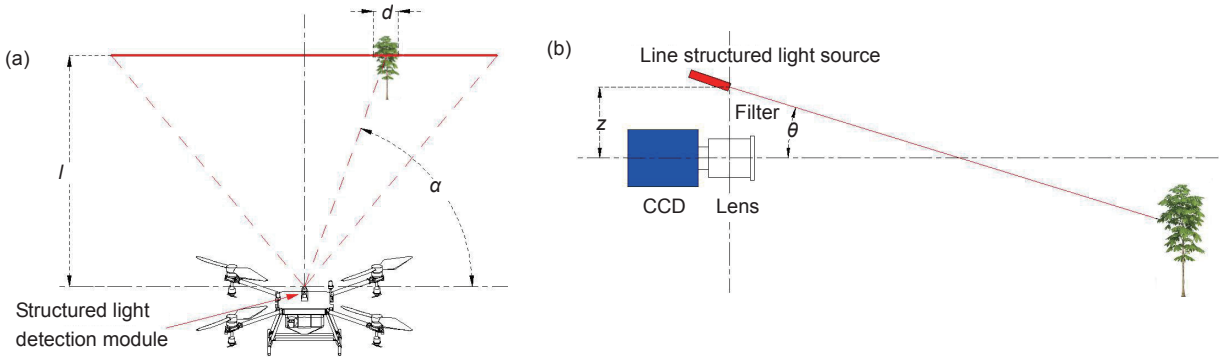

Illustration of plant protection UAV obstacle detection based on line structured light. (a) Illustration of structured light scanning; (b) Illustration of structured light detection module

Overview: With the rapid development of UAV technology, the applications of plant protection UAV are more and more common. At present, most of the plant protection UAV is a semi-automatic operation with manual intervention. UAV needs to manually avoid obstacles, when it encounters obstacles during plant protection operations. Developing the automatic plant protection UAV with automatic obstacle avoidance is particularly important. However, the current UAV obstacle avoidance technology is not mature. To solve the obstacle avoidance problem of plant protection UAV in operation, especially for farmland areas, a technology based on structured light vision was proposed as shown in Fig. (a). Based on the laser triangulation principle, through the special optical path design between the semiconductor laser and CCD sensor, an optical detection system to detect front obstacle information was designed. The compositions of this optical detection system were the line structured light source, CCD camera, optical lens and filter device as shown in Fig. (b). They were fixed by specific designed structure. The distance between the line structured light source exit hole and the CCD imaging optical axis was designed as '*z*'. The angle between the optical axis of the line structured light source and the CCD imaging optical axis was designed as '*θ*'. The parameters '*z*' and '*θ*' both required to be calibrated before detection. The line structured light emitted by the laser was reflected by the surface of the obstacle and was imaged on the CCD target surface. Because of the narrow bandwidth of the original image obtained by CCD maintained obvious image with line structured light and some optical noises. The processing such as image segmentation, linear image denoise and refinement were needed to extract the clear image of the line structured light. The information of front obstacle was contained by the position of the line structured light image in the whole image and the length of it. Through the image acquisition, processing and calculation, the distance, azimuth, width and other parameter information of front obstacle could be extracted. Experiments show that this method can effectively detect the distance, azimuth and width of the obstacle in the unknown environment. The deviation of distance detection is less than 0.06 m. The deviation of azimuth detection is less than 4°. The deviation of width detection is less than 0.01 m. The study of this method provides a theoretical basis for further realizing the function of automatic obstacle avoidance of plant protection UAV.

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