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采摘机器人振荡果实匹配动态识别

Research on matching recognition method of oscillating fruit for apple harvesting robot

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中文关键词：图像识别,算法,采摘,机器人,振荡,模板匹配

英文关键词：image recognition algorithms harvesting robots oscillation template matching matching recognition

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中文摘要：

　　为解决由于果实振荡影响采摘机器人识别定位时间，进而影响采摘速度和效率的问题，对采摘机器人在果实振荡状况下的匹配动态识别方法进行了研究。首先介绍了振荡果实的动态识别流程，确定出采摘目标果实作为后续匹配识别的模板；然后引入去均值归一化积相关匹配识别算法，采用Fast Inverse Square Root算法和快速哈特莱变换对其进行加速优化，同时借鉴以往旋转无关匹配识别算法进行抗旋转改进；试验结果表明，加速优化后的匹配识别算法能够进行采摘目标果实的匹配识别，单幅平均匹配识别时间为0.33 s，经过抗旋转等改进的匹配识别算法在[-55°，60°]较大范围内旋转无关，可以准确识别振荡果实，加上模板适时更新，能够满足实际需求。该研究可为果蔬采摘的动态识别提供参考。

英文摘要：

　　Abstract: When the harvesting robot picks fruits, the separation of fruit and fruit branch leads to the other fruits oscillating on the fruit tree, using the cut way or twist way. In addition, the wind also leads to the fruit oscillating. In the past, the harvesting robot using the static recognition method recognized them accurately when the oscillating fruits would stop and either wait or frequently recognize them in the process of the fruits' oscillation, which spent more picking time and influenced the total picking efficiency of the harvesting robot. Because the static recognition method cannot obtain the dynamic characteristics of the oscillating fruit, the harvesting robot cannot accurately pick them during the fruits' oscillation. It is obvious that the static recognition method cannot meet the fast picking requirement of the oscillating fruits. In order to resolve the problem that the fruit oscillation influences on its recognition, orientation, and then fast picking, the dynamic recognition method under the fruit oscillation condition for the harvesting robot was researched. In the first place, the dynamic recognition process of oscillating fruit was introduced. The picking target fruit was determined which would be taken as the template of the following recognition. In the next place, the Fast Inverse Square Root algorithm and Fast Hartley Transform algorithm were applied to increase the recognition speed of the Mean-residual Normalized Product Correlation matching algorithm. Then, the fast Mean-residual Normalized Product Correlation matching algorithm was improved to be the property of resistance to rotation again, which was used to recognize the dynamic images. At last, the matching recognition tests were done, and the test results showed that the average recognition time of the improved fast algorithm was 0.33 s and the improved rotation invariant algorithm had the rotation invariance in the wide range of [?55°，60°] and could recognize the oscillatory fruit accurately. In addition, the timely update of the template was also used, which could meet the recognition requirement.

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