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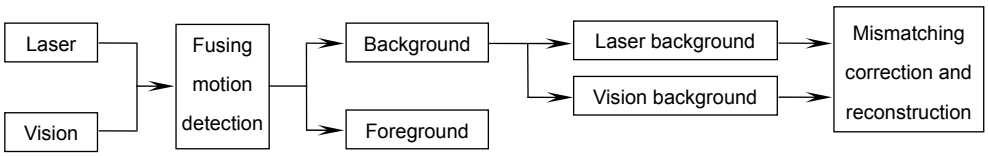
Motion detection and mismatching correction by fusing laser and vision

Qiang Zhang[1], Jianghai Zhao[1, 2]*, Yawei Yuan[1] and Shihui Fang[2]

[1]Department of Automation, University of Science and Technology of China, Hefei 230026, China;
[2]Advanced Manufacturing Technology Institute, Hefei Institute of Physical Science,
Chinese Academy of Sciences, Changzhou 213000, China



The overall design framework of fusion perception system.

Abstract: As a core technique in the video surveillance and 3D map building fields, the moving object detection and scene reconstruction are the foundations of the real-time navigation, obstacle avoidance and path planning. In the meantime, as two important sub-problems of environment perception task, they are not only closely connected with the development of many fields, such as robot, unmanned aircraft, unmanned vehicles and body feeling game, but also are the part of the lives of human intelligence. The current research is mainly based on single laser sensor or single vision sensor. It is difficult to meet the requirements of real-time multi task scenario due to the limitation of the visual field, the amount of data, the richness of the data, the real-time and the anti-jamming. Based on the mutual supplement and constraint of the laser information and the visual information, an implementation system for fusing laser and vision was designed. In addition, two improved algorithms were proposed to solve the problems of the error foreground detection in the motion detection and the mismatching between the point clouds of different sensors.

As for motion detection, aiming at the error detection for uncovered background area, a novel fusion motion detection algorithm based on foreground clustering was proposed. This algorithm of laser information motion detection was operated by relating fusing visual system. The 2D foreground and background of visual system were firstly detected based on visual background subtraction algorithm. Then the laser points mapped the visual 2D image by the joint calibration matrix. And then the visual foreground clustered regarding laser foreground points as the heuristic information. In order to solve the problem of the noise in the fusion and the mismatch of the point cloud directly, which was caused by the direct registration based on the external calibration relationship between the sensors, related optimization strategies were proposed before the scene reconstruction. ICP algorithm, a novel mismatching correction algorithm was proposed. The laser and vision point cloud were segmented into clusters based on the cell mismatching degree firstly. Then the corresponding stereo point cloud was registered referring to laser clusters. The corrected point cloud could be used for further verification by reconstructing the scene after filtering.

The advantages of visual texture features and real-time combined the accuracy and robustness of laser, and a fusion system used for dynamic scene awareness was designed. In this multi-sensor fusion system, the laser and visual information could check and complement each other. The experimental results showed that the fusion foreground obtained finally had a better robustness to shadow. Compared with the whole registration correction, the average mismatching degree reduced by 75%, and the positive ratio in the direction of y and z converged at least 5%.

Keywords: fusion of laser and vision; motion detection; uncovered background area; mismatching distortion; scene reconstruction

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