Robot vision localization system based on image content matching

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Abstract: Self-localization and mapping is an important and difficult problem for mobile robot. Reliable and low cost solution for this issue would promote the development of robotics industry. A robot vision localization system is presented in this paper, which can take advantage of global keyframes navigation map for robot self-localization. And two common problems for robot self-localization, including solve kidnap problem and similar objects interference, can be solved through this localization system, which could fix robot position by matching with global map according to the graphic content in the robot vision. The core of this system is graphic content matching, and composed by two parts: image overlap region extraction and overlap region rebuilding through sub-blocks matching. This method could match image content effectively. If two frames take some same objects, there would be some overlap regions between them. And the overlap regions between two frames can be obtained by translating and rotating these frames according to their matched feature points on the ceiling firstly. And a special designed ceiling feature point extraction and matching method is presented, and the interference caused by points on the wall and mismatching sub-blocks can be deleted according to the features of ceiling structure. After overlap region extraction, the graphic content matching can be processed in these regions. Through image matching, this localization system can make good use of the different objects and their layout in different rooms or corridors as landmarks. These landmarks can be used to fix robot global position precisely in the large indoor space, which is composed of multi-rooms and corridors. By taking advantage of image content, this vision system could make good use of the different objects in different rooms and cannot be disturbed by similar objects, which is common interference for global indoor environment localization. However, there would be some new interference for graphic content matching. The main interference is image distortion, which is caused by camera angle and robot movement. In order to revise image distortion and localize robot exactly, a graphic content matching method is presented. According to the features of image distortion, this matching method is designed through sub-blocks matching in the overlap regions between two frames. It could calculate the images similarity by adjusting the images to the same distortion. In the experiment, this graphic matching method can match the real-time robot vision with global keyframes map effectively, and find out the most similar keyframe for each vision image and fix robot position exactly. More than 95% robot vision can be matched and position RMSE<0.5 m. Robot can also localize itself effectively when it is kidnapped.

Keywords: robot localization; graphic content matching; image distortion; image overlap region; overlap region rebuilding


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