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LIDAR Based Cooperative Mapping for Multiple Robots with Efficient Rendezvous Point Detection

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ABSTRACT

In the past few years, intelligent robot has been widely studied and applied in various fields, and has a broad development prospect. The problem of studying the robot's autonomous localization in an unknown environment and constructing a map of the environment is called SLAM(Simultaneous Localization and Mapping). Compared with single robot mapping, multi robots cooperative mapping can save running time, improve work efficiency, and increase the robustness of mapping. It has important research significance in SAR (Search and Rescue), military investigation, automatic chemical plant and other tasks which require accuracy and time constraints. In the problem of multi robots cooperative mapping, the key point is how to recognize the rendezvous signals efficiently and robustly from multiple robots and so that a globally consistent map can be constructed by matching and merging maps from individual robots. This paper studies this problem and proposes a novel solution.

More specifically, an online multi-robot cooperative mapping method based on LIDAR (LIght Detection And Ranging) is studied. We explore rendezvous detection algorithms with and without GPS information respectively based on the fact that although GPS information can serve as a very straightforward initial indication of robot meeting each other, there are many occasions and scenarios where GPS information are non-reliable or simply unavailable. Point cloud data obtained from LIDAR sensor is the main focus of this work. Critical tasks in cooperative mapping such as robot odometry, place recognition, map matching and optimization are all done based on point cloud processing algorithms. We integrate the state of the art components as well as proposed new algorithms such as point cloud segment based rendezvous detection to facilitate robust and efficient cooperative mapping among robots. Extensive experiments are done to test the efficacy of the proposed system.

Keywords: LIDAR, SLAM, GPS, Cooperative Mapping

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