Individual Assignment: Robot Video

Assignment Overview

Find an online video that showcases a mobile robot in action and write a short text about it. In the text, you need to describe the type of the robot, its main task and why that task is relevant. For instance, how could that robot potentially improve human life? Further, identify one major difficulty that the robot might face to reach its goal, i.e., why is the task non-trivial? or what are the safety concerns? Finally, briefly outline what method or technology was deployed to overcome that obstacle, or, if that is not clear from the video, name a state-of-the-art solution for the problem. You can take the description of the Shakey video as inspiration. Try not to pick the most obvious videos, you will be given an extra point for originality!

I chose to write about the paper "RGB-D SLAM in Indoor Planar Environments with Multiple Large Dynamic Objects" by Long, Ran, et al. (2022)[1]. I was inspired by their novel approach to dense RGB-D SLAM in dynamic planar environments, which enables simultaneous multi-object tracking, camera localization, and background reconstruction.

As we know, SLAM is a key component of autonomous navigation, but enabling SLAM in dynamic environments while differentiating multiple dynamic objects presents several challenges. In dynamic situations where the number of dynamic objects is also changing, the static background is considered to dominate the camera view. However, without semantic segmentation, dynamic objects that occupy a large portion of the camera view may be misclassified as static background, the majority of color and depth information may be occluded by moving objects, and the remaining static visual input may not be sufficient for an effective camera estimation. Many dynamic SLAM algorithms have considered multiple dynamic objects, but they either rely on semantic segmentation or assume that the largest rigid body in the camera view is the static background.

Long et al. propose a hierarchical image representation that extracts planes from planar areas and over-segments non-planar areas into super-pixels. This method concurrently segments and tracks multiple dynamic planar rigid objects while eliminating dynamic non-planar objects to enable camera localization and mapping. They assume that planes cover a large part of the environment, including both the static background and the rigid moving objects. This unique technique for online multi-motion segmentation based on planes in indoor dynamic situations, coupled with a novel process that simultaneously tracks multiple planar rigid objects, predicts camera ego-motion, and reconstructs the static background, results in an RGB-D SLAM technique that is resistant to camera view occlusion induced by many big dynamic objects.

Long et al. evaluated their proposed method using sequences collected with a Kinect RGB-D camera mounted on an omnidirectional robot. The dynamic objects were created from stacked boxes and were either moved by humans or via a remotely controlled KUKA youBot. The results of the evaluation showed that the proposed method outperformed other methods in planar dynamic environments.

The authors' research presents a unique technique for online multi-motion segmentation based on planes in indoor dynamic situations, a novel process that simultaneously tracks multiple planar rigid objects, predicts camera ego-motion, and reconstructs the static background, and an RGB-D SLAM technique that is resistant to camera view occlusion induced by many big dynamic objects. Their method was evaluated using sequences collected with a Kinect RGB-D camera, mounted on an omnidirectional robot, with dynamic objects created from stacked boxes that were moved either by humans or via a remotely controlled KUKA youBot. The evaluation showed that the proposed method outperforms other methods in planar dynamic environments.

In summary, the work presented in "RGB-D SLAM in Indoor Planar Environments with Multiple Large Dynamic Objects" is an innovative contribution to the field of SLAM, which I found inspiring in robotics.

https://youtu.be/iMTop_1glSc

[1]. Ran Long, Christian Rauch, Tianwei Zhang, Vladimir Ivan, Tin Lun Lam and Sethu Vijayakumar , RGB-D SLAM in Indoor Planar Environments with Multiple Large Dynamic Objects, IEEE Robotics and Automation Letters (RAL), vol. 7(3), pp. 8209-8216 (2022).