AN ADAPTATIVE REGISTRATION OF RGB-D DATA FOR 3D INDOOR ENVIRONMENT MAPPING

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This work presents an adaptive registration of RGB-D data for 3D mapping. The goal of this research is to build a 3D map close, as much as possible, to the real environment. This is achieved by considering a XYZ weighting coefficients derived from a theoretical random error model proposed by (Khoshelham and Elberink, 2012). The most important existing 3D mapping methods using RGB-D cameras are based on 3 steps: firstly, a feature-based tracking technique is performed for extract and matches 2D feature in the RGB images and their associated depth values are used for a pair wise registration. After, the initial approximation obtained in the first step must be improved using a variant of the iterative closest point (ICP) algorithm. Finally, the loop closure is detected and a global consistency of the complete data sequence is performed using pose graph optimization to minimize the registration errors. The main advantages of the RGB-D sensor are its portability, the capacity of capturing depth and color data at once, and its relatively low cost when compared with concurrent technologies such as laser scanner or time-of-flight (TOF) cameras. Visual features are detected in the RGB frames and correspondences are automatically obtained using speeded up robust features (SURF) algorithm. We also present an epipolar search method for accurate transformation of the keypoints from 2D to 3D space, and define weights for the 3D points based on the theoretical random error of depth measurements. The initial registration is calculated using the 3D similarity model and the least square method (LSM). Then, the initial approximation obtained is improved using a normal distribution transform (NDT) algorithm. Because registration of RGB-D data is often influenced by the random error of individual 3D points, in a long sequence, these errors accumulate and lead to inaccurate and deformed point clouds, particularly in situations where loop closing is not feasible. Our approach detects loop closures and in order to generate globally consistent alignments we proposed a General Framework for Graph Optimization (g2o), which edges of the graph is composed by posteriori sigma determined in the LSM. Our results show that the weighting the 3D points improves the accuracy of sensor pose estimates along the trajectory. We also demonstrate the potential of sigma posteriori for the framework optimization.

Keywords: indoor mapping, RGB-D sensor, g2o, loop closing.