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ОПТО-ИНЕРЦИАЛЬНО-ОДОМЕТРИЧЕСКАЯ ЛОКАЛИЗАЦИЯ И КАРТИРОВАНИЯ ДЛЯ НАЗЕМНОГО МОБИЛЬНОГО РОБОТА В ПОМЕЩЕНИИ С ИСПОЛЬЗОВАНИЕМ ОГРАНИЧЕНИЙ SE2-XYZ

VISUAL-INERTIAL-ODOMETRIC LOCALIZATION AND MAPPING FOR INDOOR GROUND MOBILE ROBOT USING SE2-XYZ CONSTRAINTS

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Abstract: In this work, we develop a feature-based real-time Visual-Inertial-Odometric system that operates in an indoor environment for Ground Mobile Robots. The system is based on the opensource ORB-SLAM system, and it is optimized to work better for ground mobile robots by adding SE2-XYZ constraints, which constraint the movement along the Z-axis.

Introduction: The pose of a robot can be interpreted in a multi-dimensional space. An arbitrary pose point in this space should describe the position and the orientation of the mobile robot, this pose is parameterized in SE(3) space. SE(3) space is redundant for the indoor ground mobile robot, and it is enough to represent the pose in the SE(2) space (XY for position and Yaw for rotation). However, SE(2)-constraints are not precise enough in cases when there are rough paths or when the vehicle is shacking. Recent SLAM systems tend to deprecate odometry data from the robot due to inaccuracy affected by wheel slip in uneven terrain or other adverse conditions. Although, Odometry data might be very useful in cases where the Optical Information is bad, due to illumination problems. Inertial Data from IMU will also provide more accuracy for optical tracking and robustness in cases where optical information is bad.

Main part: In our system, we use a simpler algorithm that directly formulated vehicle state on SE(2), moreover, the out-of-SE(2) motion perturbations are considered by using SE(2)-XYZ constraint. It associates SE(2) poses and 3D poses landmarks via optical features. In the term of odometric measurement, we use the pre-integration algorithm on SE(2). Employing these constraints and building on the ORB_SLAM system, a complete visual-inertial-odometry simultaneous localization and mapping system for the indoor ground mobile robot is developed in graph optimization formulation. The graph optimization included both Pose Optimization for good localization and Bundle Adjustment for better mapping.

Conclutions: Our SLAM system is expected to have superior performance in the term of accuracy and robustness compared with common visual SLAM systems that parameterize the vehicle pose with SE(3) in the indoor ground mobile robot datasets, also the trajectory on Z-axis is improved using our graph optimization models.

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