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Outdoor Application of Visual-Inertial Odometry and SLAM Techniques

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Today, Unmanned Aerial Vehicle (UAV) applications are rapidly evolving, increasing the need for vision-based localization methods without GNSS. This study aims to enhance the accuracy of UAV geographic coordinates in GNSS-denied environments by improving Visual Inertial Odometry (VIO) and SLAM techniques, with results observed in simulation environments and popular datasets. Our solution is specifically designed for long-range and high-altitude fixed- wing UAV platforms.

Among the VIO and SLAM techniques, three prominent approaches ORB-SLAM3 [0], VINS-Fusion [1], and MSCKF [2] offer advantages suitable for GNSS-denied positioning strategies. These methods are planned to be utilized and further developed in our study.

In the Gazebo simulation environment, three different outdoor datasets named RECT300, LINE700, and CIRCLE1200 were created, corresponding to flights conducted at altitudes of 300, 700, and 1200 meters, respectively. The VINS-Fusion simulation flight was tested using the RECT300 flight pattern. The flight pattern is shown in the images below.

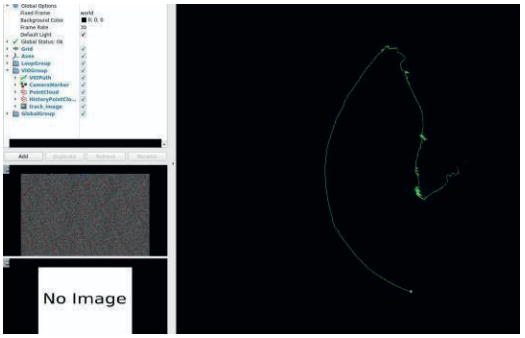


Figure 1: VINS-Fusion, RECT300 flight result



Figure 2: Gazebo simulation & flight pattern

References:

[1] Campos, Carlos, et al. "Orb-slam3: An accurate open-source library for visual, visual–inertial, and multimap slam." IEEE Transactions on Robotics 37.6 (2021).

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