Visual-Inertial Localization With Prior LiDAR Map Constraints

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Abstract— In this letter, we develop a low-cost stereo visual-inertial localization system, which leverages efficient multi-state constraint Kalman filter (MSCKF)-based visual-inertial odometry (VIO) while utilizing an a priori LiDAR map to provide bounded-error three-dimensional navigation. Besides the standard sparse visual feature measurements used in VIO, the global registrations of visual semi-dense clouds to the prior LiDAR map are also exploited in a tightly-coupled MSCKF update, thus correcting accumulated drift. This cross-modality constraint between visual and LiDAR pointclouds is particularly addressed. The proposed approach is validated on both Monte Carlo simulations and real-world experiments, showing that LiDAR map constraints between clouds created through different sensing modalities greatly improve the standard VIO and provide bounded-error performance.

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