**Performance Evaluation of Monocular Visual Odometry in Low-light Conditions and Narrow Field of View**

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***ABSTRACT***

Monocular Visual Odometry (MVO) is a key technology in autonomous driving, determining the vehicle's relative position and orientation using a single camera. Recent SLAM(Simultaneous Localization and Mapping) research focuses on enhancing model robustness, particularly by mitigating the effects of rotation and lighting variations during vehicle movement. Low-light conditions, which degrade feature visibility and descriptor performance, significantly impact algorithm performance. A camera with narrow field-of-view limits the number of reliable tiepoints and the range of their disparity changes. In this study, photogrammetric relative orientation is utilized to analyze MVO performance in low-light environments and narrow field of view. Using the KITTI benchmark dataset, experiments were conducted under these conditions to evaluate system robustness and accuracy. For MVO, geometric transformations between consecutive frames are estimated using relative pose estimation. Feature extraction employs the Shi-Tomasi corner detection method, and KLT feature tracking is used. During geometric estimation, the applicability of relative pose estimation is verified for images moving along the optical axis. Given the use of a monocular camera, scale estimation is based on the known height from the ground to estimate displacement. RANSAC is subsequently used to remove outliers and improve estimation accuracy. In low-light conditions, brightness values are reduced by 20, 30, or more digital numbers (DN), with contrast decreased by 20% after brightness adjustment. Considering the urban environment of approximately 4.1 km with 4,540 frames and a residential area of approximately 2.2 km with 2,760 frames, the system demonstrated robustness despite low-light conditions. Results showed that reducing brightness by 50 or more DNs made it difficult to visually distinguish images. When brightness was reduced by 20 pixels, RMSE increased by 6.4% in urban environment, and 7.4% in residental area compared to the original MVO. This results highlight the potential of photogrammetry-based calibration in enhancing MVO performance under challenging topics scenarios.

**Keywords:** monocular VO, Low-light environment, monocular Benchmark, Narrow FOV, relative orientation, (maximum 5 words)