How does the computational throughput of semantic-guided diffusion fusion in multimodal VSLAM systems scale wi

Assignee Research

June 10, 2026

Abstract

Recently neural radiance fields (NeRF) have been widely exploited as 3D representations for dense simultaneous localization and mapping (SLAM). Despite their notable successes in surface modeling and novel view synthesis, existing NeRF-based methods are hindered by their computationally intensive and time-consuming volume rendering pipeline. This paper presents an efficient dense RGB-D SLAM system, i.e., CG-SLAM, based on a novel uncertainty-aware 3D Gaussian field with high consistency and geometric stability. Through an in-depth analysis of Gaussian Splatting, we propose several techniques t

1 Introduction

This paper examines: CG-SLAM: Efficient Dense RGB-D SLAM in a Consistent Uncertainty-aware 3D Gaussian Field. Research question: How does the computational throughput of semantic-guided diffusion fusion in multimodal VSLAM systems scale with increasing input resolution compared to early fusion baselines, measured using the FPS metric on standard benchmarks like KITTI or TUM RGB-D?.

2 Methodology

Systematic literature search across multiple databases yielded 8 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 5.2/10.

3 Results

8 papers retrieved. 9 claims extracted; 1 independently verified. Quality review score: 5.2/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
CG-SLAM consistently achieved the best ATE RMSE performance on the Replica dataset across 8 individual scenes and on ave	×	0.05
GS-SLAM and SplaTAM are concurrent works with CG-SLAM.	×	0.09
The CG-SLAM system incrementally generates a stable, consistent, and uncertainty-aware Gaussian field given a set of RGB	✓	0.20
The system incorporates an uncertainty modeling module that utilizes geometry prior to attach uncertainty properties to	×	0.06
The uncertainty modeling strategy helps remove outliers in mapping and makes full use of informative Gaussians in tracki	×	0.05
The system uses innovative loss terms to ensure geometry stability and accuracy.	×	0.04
Minimizing the re-rendering loss from low-uncertainty primitives enables the construction of a real-time and accurate tr	×	0.06
3D Gaussian Splatting defines a 3D scene as a set of anisotropic Gaussian distributions associated with means X $\in$ R3 and	×	0.08
In 3D Gaussian Splatting, the covariance matrix Σ is decomposed into R and S (Σ = RSS^T) to ensure it remains positive s	×	0.07

References

- http://arxiv.org/abs/2504.02477v3
- http://arxiv.org/abs/2301.08930v2
- http://arxiv.org/abs/2403.16095v1