From Dark Flash Images to Relightable 3D Scenes with Photometric Stereo Priors

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Motivation & Methodology

- Current Problem:

  Existing neural rendering methods often struggle in low-light conditions, leading to geometric artifacts.

- Ideas:

- We propose Dark-2DGS, a novel framework combining Photometric Stereo (PS) priors with 2D Gaussian Splatting. By utilizing multi-view flash images, we extract high-fidelity material maps to guide the geometry optimization in a coarse-to-fine manner, enabling robust reconstruction and inverse rendering.

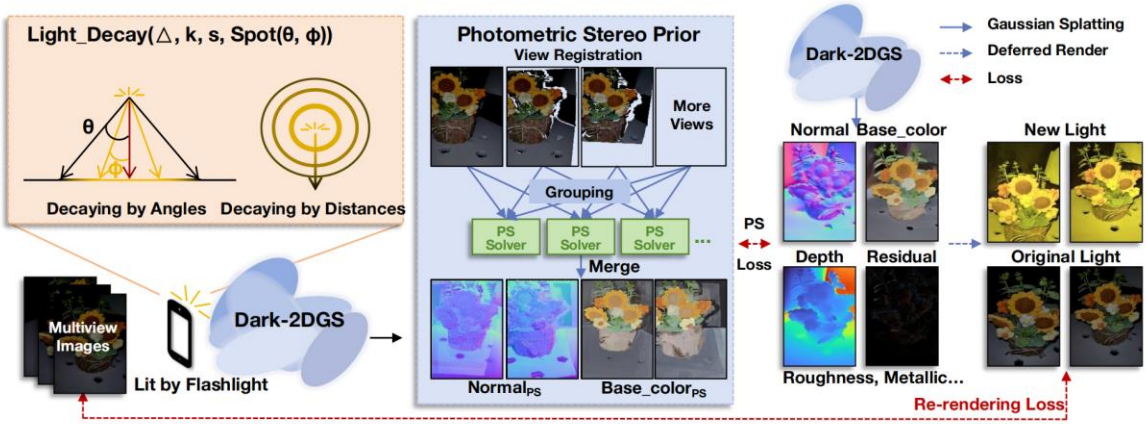
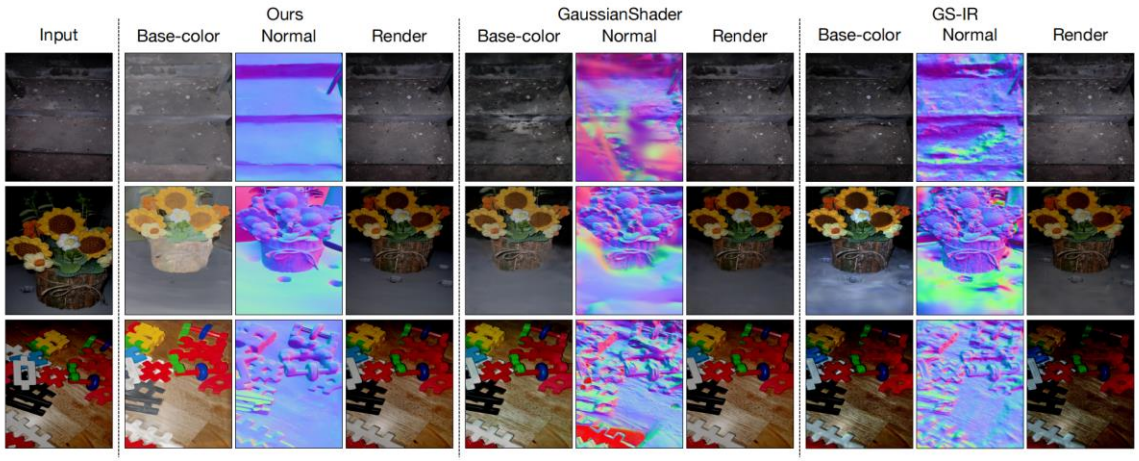


Fig. 1: The framework of Dark-2DGS. We integrate photometric stereo priors into 2DGS optimization to recover fine geometry and decompose scene attributes for relighting.

Experimental Results

- Performance:
  - Extensive experiments on real and synthetic datasets demonstrate that our method significantly outperforms SOTA low-light view synthesis approaches.
  - Conclusion: Dark-2DGS effectively eliminates flash reflections and reconstructs geometric details. The disentangled reflectance and normal fields facilitate realistic real-time relighting under arbitrary illumination.



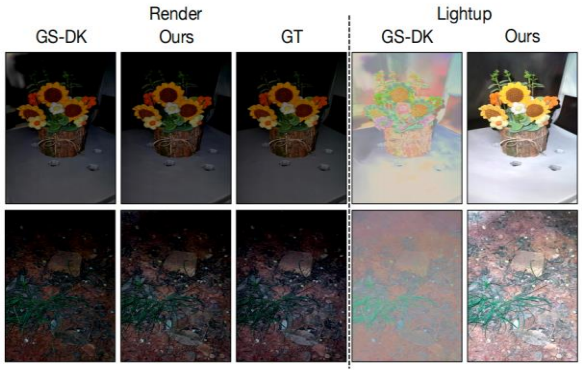


Fig. 2: (Left) Visual comparisons showing our method recovers superior details compared to baselines. (Right) High-quality relighting results under novel illumination conditions.