

P4: Machine Learning, Intelligent Systems & AI for Science and Engineering

7. Stereoscopy Reveals What 2D Metrics Miss: Robust 3D Gaussian Splatting Initialization for VR

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Abstract: Stereoscopic displays are fundamental to virtual reality (VR), providing depth perception through binocular viewing. Recent advances in 3D Gaussian Splatting (3DGS) enable high-quality novel view synthesis, making it well suited to immersive VR. However, when only a limited number of images are available for optimization, 3DGS produces geometric artifacts such as floaters and misplaced structures due to under-constrained reconstruction. While these artifacts appear subtle under conventional image-based evaluation, they become far more noticeable during stereoscopic viewing, where geometric inconsistencies disrupt binocular fusion and degrade the experience.

In this work, we investigate how such reconstruction artifacts affect stereoscopic perception in head-mounted displays (HMDs). To improve geometric consistency, we initialize 3DGS with the union of a Structure-from-Motion point cloud (COLMAP) and a dense geometric prior from the Visual Geometry Grounded Transformer (VGGT). This hybrid initialization increases scene coverage while preserving accurate camera geometry, and requires no modification to the underlying 3DGS optimization. We evaluate the approach using standard image-quality metrics and a controlled stereoscopic user study in VR. Although 2D metrics register only a modest difference, participants in the HMD study show a strong and consistent preference for our method, revealing that stereoscopic viewing is far more sensitive to these reconstruction errors than conventional metrics suggest.