A VR Dive into 3D Gaussian Splatting

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Abstract

The demand for high-quality, immersive experiences in eXtended Reality (XR) environments has increased significantly, driven by applications in entertainment, education, healthcare, robotics and industrial design. XR technologies rely heavily on real-time rendering of 3D scenes to create interactive and responsive experiences. However, real-time visualization of complex 3D scenes in XR environments remains challenging, particularly on standalone VR devices with limited computational resources. A promising approach is 3D Gaussian Splatting (3DGS), which represents scenes as collections of 3D Gaussians and allows for novel view synthesis while preserving structural and appearance details, and proving to be lighter than traditional methods. Achieving smooth, immersive experiences in VR, 3DGS requires optimizations to balance performance and visual fidelity, ensuring a high quality of experience (QoE) for users.

This demo presents a system for immersive VR exploration of 3DGS scenes on a Meta Quest Pro headset. The system implements a semantic and viewpoint-aware Level of Detail (LoD) mechanism: rendering is tailored to specific objects that intrinsically have distinct features and complexities, determined thanks to semantic priors. Regions corresponding to semantically important objects are rendered with higher detail, while less relevant objects are simplified. Objects' importance is determined by texture and details, but also by their proximity to the user's viewpoint: farther objects require less accuracy when rendered. Moreover, rendering adapts dynamically to users' movement, allowing free 360° navigation and real-time interaction with the scene, while adapting objects' quality based on the speed and viewpoint characteristics.