Magic3D: High-Resolution Text-to-3D Content Creation

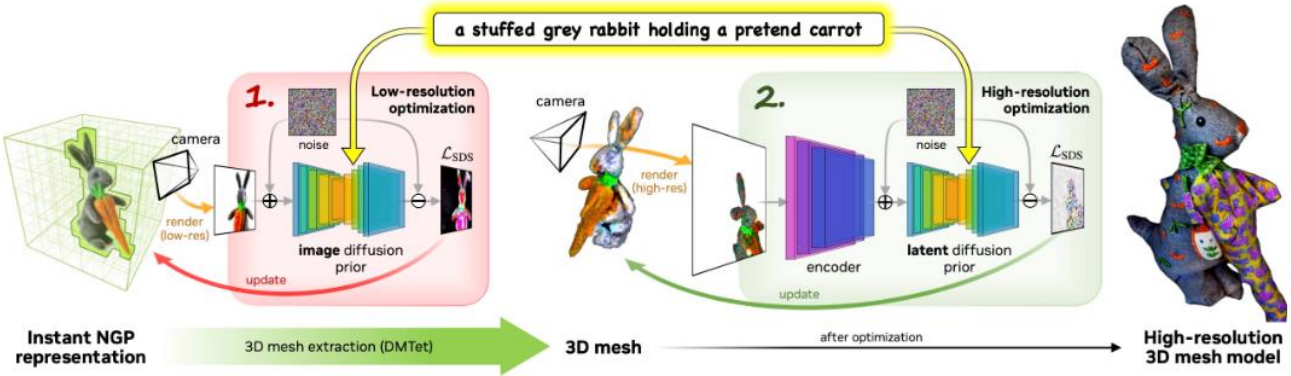
What is the problem?

The existing text-to-3D synthesis method, DreamFusion, uses a pre-trained text-to-image diffusion model to optimize Neural Radiance Fields (NeRF). However, it faces two significant challenges:

1. **Slow Optimization**: The optimization of NeRF is extremely slow, making the process time-consuming.
2. **Low-Resolution Output**: DreamFusion applies low-resolution image supervision on NeRF, resulting in low-quality 3D models.

What has been done earlier?

DreamFusion demonstrated promising results for 3D synthesis from text, but it requires long processing times (around 1.5 hours) and produces relatively low-resolution models.



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What are the remaining challenges?

1. **Speed**: The slow optimization process of NeRF limits the efficiency and practicality of generating high-quality 3D models.
2. **Quality**: Low-resolution image space supervision leads to low-quality 3D models, making it difficult to achieve detailed and high-resolution outputs.

What novel solution proposed by the authors to solve the problem?

The authors introduce a **two-stage optimization framework**:

1. **Coarse Model Creation**: First, a coarse 3D model is generated using a low-resolution diffusion prior, accelerated by a sparse 3D hash grid structure.
2. **High-Resolution Optimization**: Using the coarse model as an initialization, they optimize a textured 3D mesh model with a differentiable renderer that interacts with a high-resolution latent diffusion model.

This method, **Magic3D**, creates high-quality 3D models in 40 minutes, which is **twice as fast** as DreamFusion, and achieves higher resolution. Additionally, image-conditioned generation capabilities give users more control over 3D synthesis, broadening the scope of creative applications.

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