Differentiable Rendering of Sparse SDFs

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Abstract

3D reconstruction has achieved notable development over the past decade with the emergence of differentiable rendering – a powerful tool that has spawned a wide variety of methods. One group of methods is aimed at reconstructing objects represented by SDF grids within the framework of physically-based rendering. A major drawback of such an approach is the rapid growth of memory consumption when reconstructing models with fine details. In this work, we propose an adaptation of the differentiable rendering method for SDF to a sparse representation, with sparse versions of redistancing and regularization. Through this, we achieve a reduction in memory usage and more accurate reconstruction of object geometry.

1 Introduction

3D object reconstruction as (something else and then) Inverse rendering.

Inverse rendering to Differentiable rendering.

DR methods for physically-based rendering. Tell a bit about meshes and Nicolet article, then about two nonNN methods (2022,2024).

This method uses the idea of a relaxed boundary and the redistancing and regularization steps, necessary for SDF-based DR methods.

2 System Architecture

Describe architecture – components (their algorithms).

Tell about SDFs, grids, then (2022 article about SVS-SBS-etc.). This method uses SBS and Newton method for intersection and determining relaxed boundary points.

3 Implementation

Describe technical implementation. Comparisons also go here.

3.1 Sparse SDF Representaiton

3.2 Upsampling and sparsification

3.3 Redistancing

3.4 Regularization

3.5 Order of Sections

Sections should be arranged in the following order [Baumgartner *et al.*, 2001]:

1. Main content sections (numbered)
2. Appendices (optional, numbered using capital letters)
3. Ethical statement (optional, unnumbered)
4. Acknowledgements (optional, unnumbered)
5. Contribution statement (optional, unnumbered)
6. References (required, unnumbered)

References

[Baumgartner *et al.*, 2001] Robert Baumgartner, Georg Gottlob, and Sergio Flesca. Visual information extraction with Lixto. In *Proceedings of the 27th International Conference on Very Large Databases*, pages 119–128, Rome, Italy, September 2001. Morgan Kaufmann.