Learning Visibility Field for Detailed 3D Human Reconstruction and Relighting

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PROBLEM

This work aims to solve two problems in sparse-view 3D human reconstruction

- Multi-view feature **Aggregation** is ambiguous given occlusion
- Self-shadowed **Relighting** is expensive due to dense light attenuation query

SUMMARY

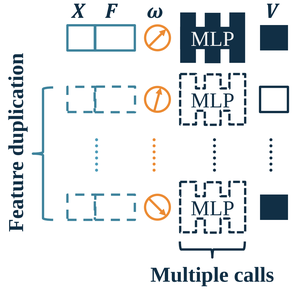
We find both can be solved by explicitly modeling a visibility field

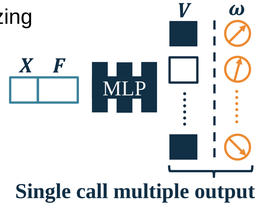
Thus, our contributions include:

- A well engineered visibility representation to improve query efficiency
- An end-to-end framework to make joint visibility learning feasible
- A simple method to regularize field alignment

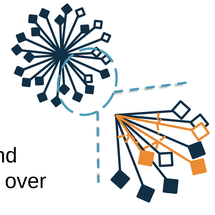
REPRESENTATION

Evaluating light attenuation is expensive even after parameterizing visibility using MLP

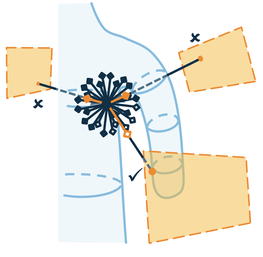




To infer other directions, we apply top-k cosine distance interpolation



Instead, we keep uniformly sampling directions fixed and use MLP to predict visibility over ALL those directions



Aggregation

We weight multi-view feature based on their visibility

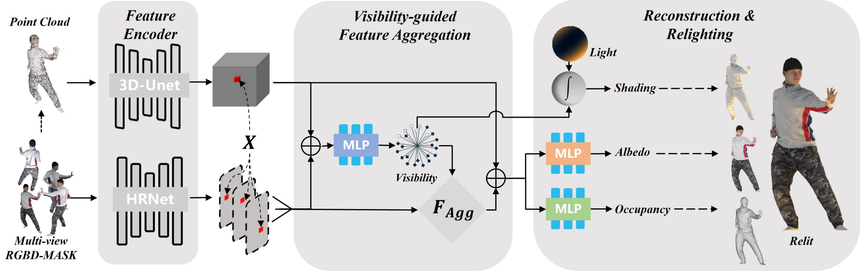
(1 MLP call plus interpolation cost)

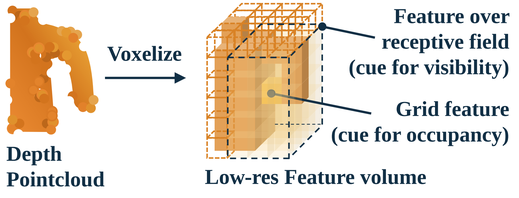
Relighting

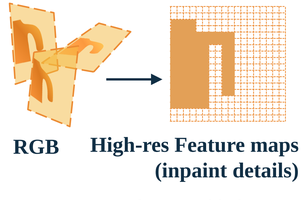
We compute hemisphere integral over fixed directions

(1 MLP call)

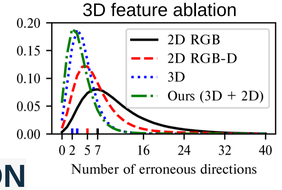
FRAMEWORK







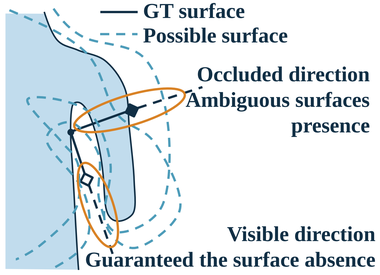
As the noisy surface samples, reasoning depth pointcloud, specifically with 3D convolution over sufficiently large receptive field, provides crucial cues for inferring underlying surface (occupancy), as well as its directional self-occlusion (visibility)



FIELD ALIGNMENT REGULARIZATION

With the bridging of 3D feature, the visibility naturally constraints the presence of surface (occupancy). By prioritizing prediction accuracy over visible directions, the fields alignment can be implicitly enforced.

In practice, we sample GT surface point with normal, compute diffuse transfer using inferred visibility and supervise it with GT



RESULTS