NeRF-MS: Neural Radiance Fields with Multi-Sequence

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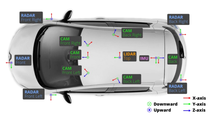
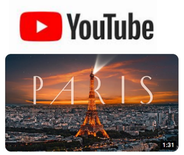
What's Multi-Sequence Data?

Multi-Time

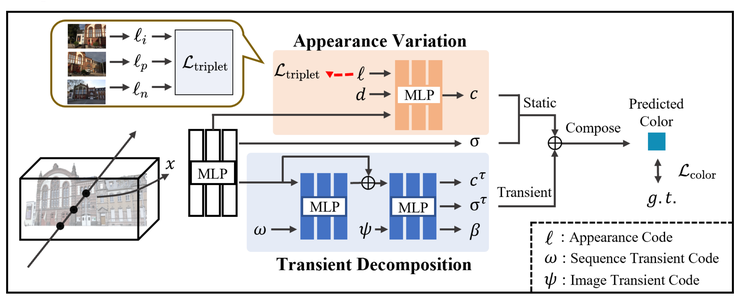


Multi-Sensor



Internet Videos

Pipeline



1. Our appearance variation module outputs the static color c based on **appearance code** ℓ_i. We use **triplet loss** to regularize the distribution of appearance code.
2. By utilizing the **image transient code** ψ_i and **sequence transient code** ω_k the transient decomposition module can effectively generate the color, density, and uncertainty for non-static objects.

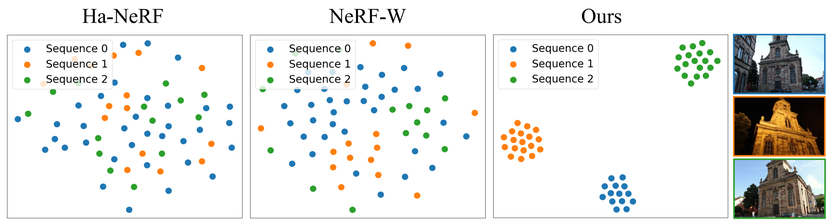
Optimization

Triplet Loss: $$\mathcal{L}_{\text{triplet}} = \frac{1}{N}\sum_{i=0}^{N-1}\max\left(\|\ell_i - \ell_p\| - \|\ell_i - \ell_n\| + m, 0\right)$$

Color Loss: $$\mathcal{L}_{\text{color}} = \sum_{\mathbf{r}\in R}\left(\frac{\|\hat{\mathbf{C}}_i(\mathbf{r}) - \mathbf{C}_i(\mathbf{r})\|_2^2}{2\hat{\beta}_i(\mathbf{r})} + \frac{\log\hat{\beta}_i(\mathbf{r})}{2} + \frac{\lambda_u}{K}\sum_{k=1}^{K}\sigma_i^{(\tau)}(t_k)\right)$$

Appearance Regularization

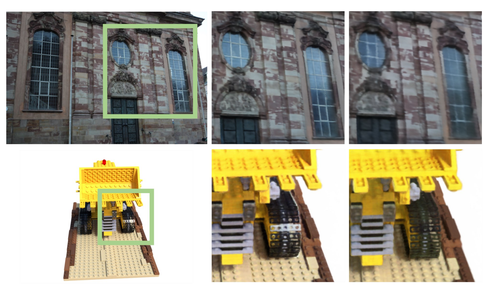
Challenge: Appearance Encoding Overfitting



The appearance codes from different sequences are overlapped due to overfitting. Thus, we leverage triplet loss to regularize the distribution of appearance codes.

Better Details and Reflections

Our method can reconstruct fine details (window dividers) and 3D consistent reflection (on windows and bulldozer tracks) by utilizing triplet loss to prevent appearance code overfitting.

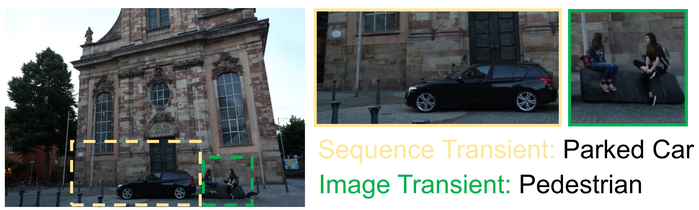


GT Ours w/o Triplet Loss

Robust Interpolation

Transient Decomposition

Challenge: Sequence Transient



Sequence Transient: Parked Car
Image Transient: Pedestrian

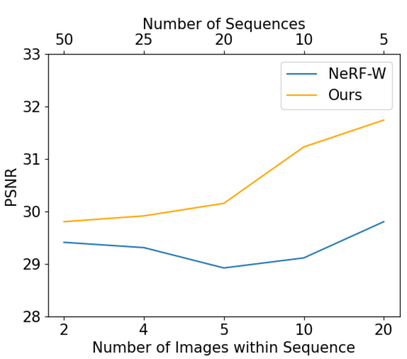
Results

NeRF-W Ha-NeRF Ours

Performance under Different Settings

Left Side: "NeRF-W" setting
Right Side: Multi-Sequence setting

We discuss the robustness of our method against different multi-sequence settings. Our method outperforms NeRF-W even in the NeRF-W like setting.



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