CSCI 5980-DeepRob - Group 7

Bringing Depth-supervision to Dynamic Neural Radiance Fields with Scene Flows

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Introduction:

The objective of this work is to investigate the impact of depth-supervised loss on both training time and performance. While the Depth-supervised NeRF paper demonstrated the effectiveness of depth-supervised loss in reducing training time for static scenes, our study aims to evaluate whether this approach can be applied to dynamic scenes. To achieve this goal, we incorporated the ds-loss into the Neural Scene Flow Fields model and conducted experiments with different loss combinations.
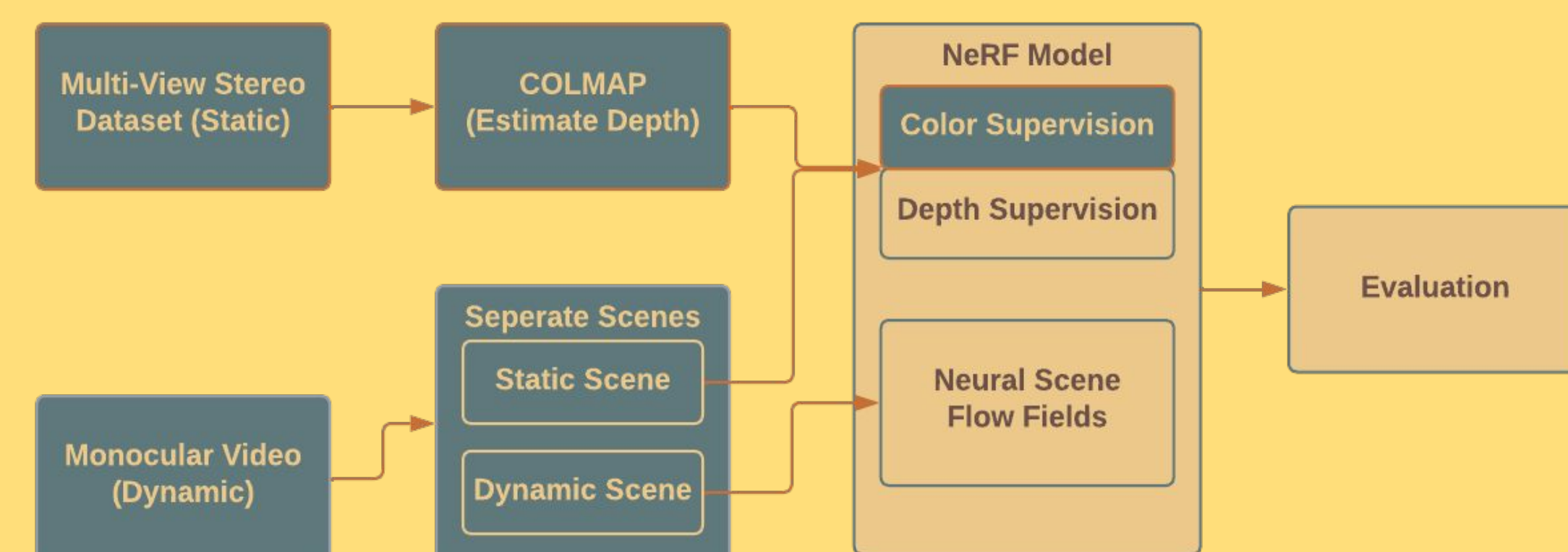
Input-output:

Static Scene:
RGB images ➡ FΘ : (x, d) ⇒ (c, σ) ➡ novel view synthesis

Dynamic Scene:
monocular video ➡ FΘ : (x, d, t) ⇒ (c, σ, $f_{t \to t \pm 1}$)
➡ space-time view synthesis

Network or Framework details:

Dataset information:

For the static scene, we used the Gopher dataset captured by Group 1. For the dynamic scene, we used the "kids running video" from the Neural Scene Flow paper. Specifically, we utilized the first 1 second of the video, which consists of 30 frames, for our experiments.
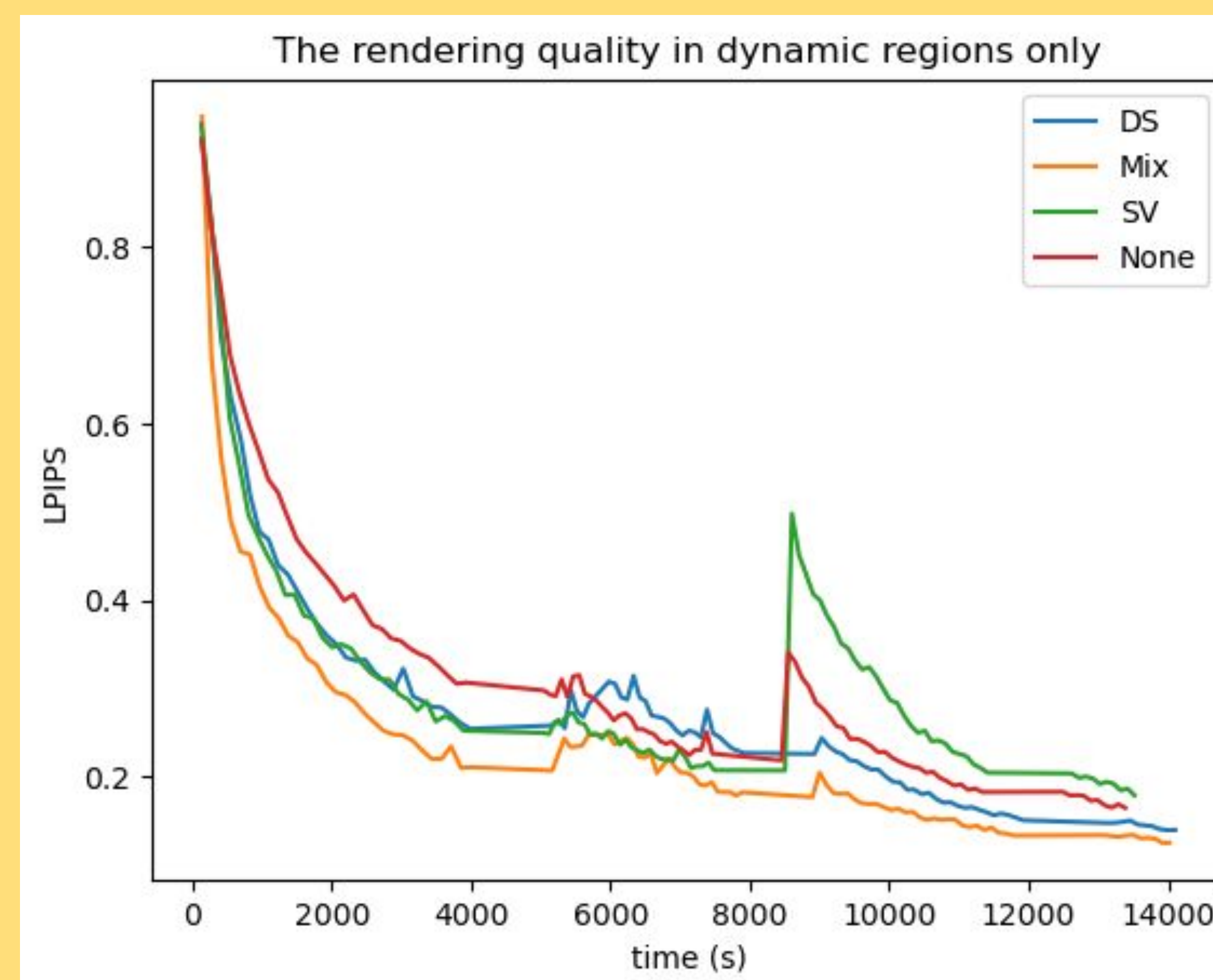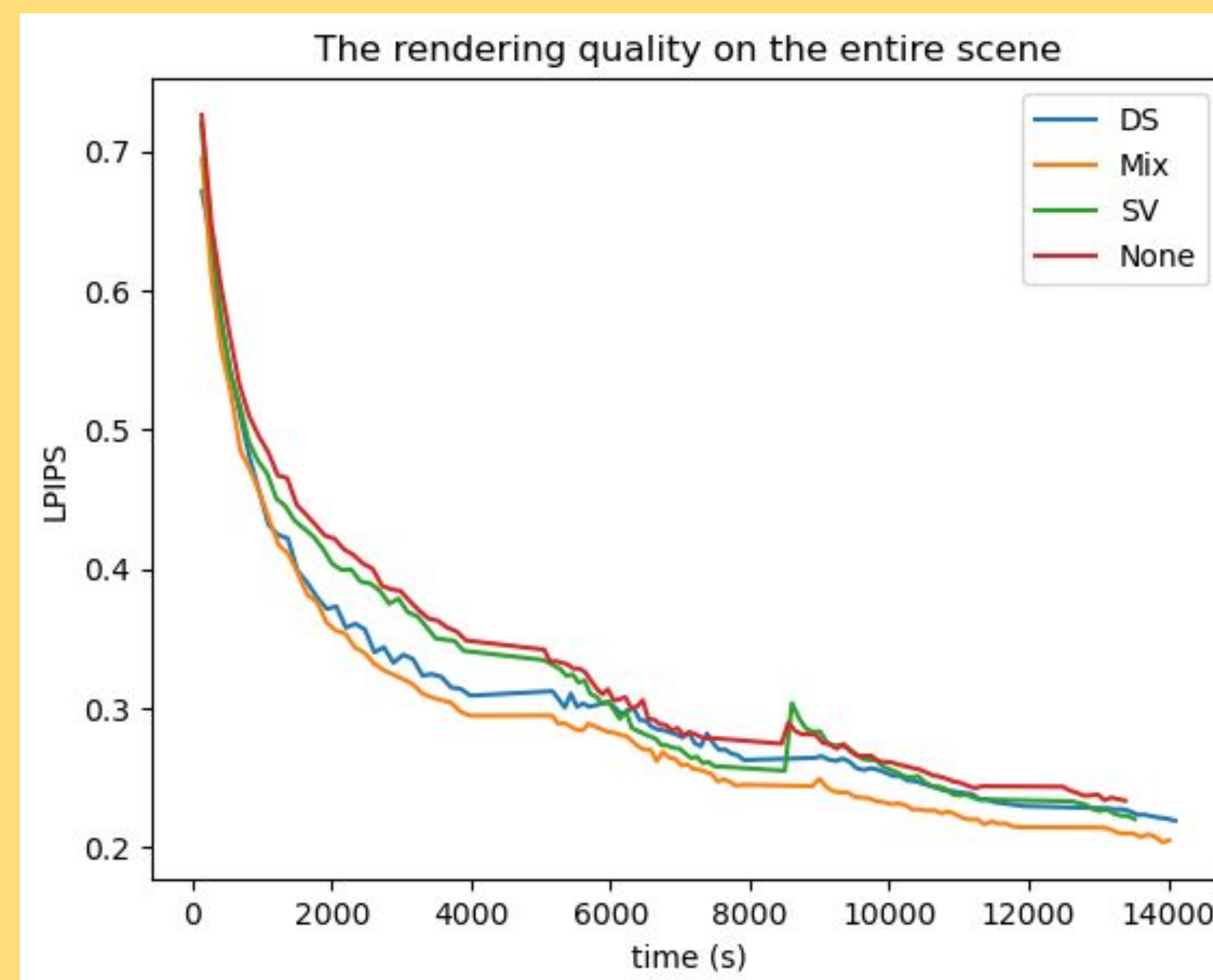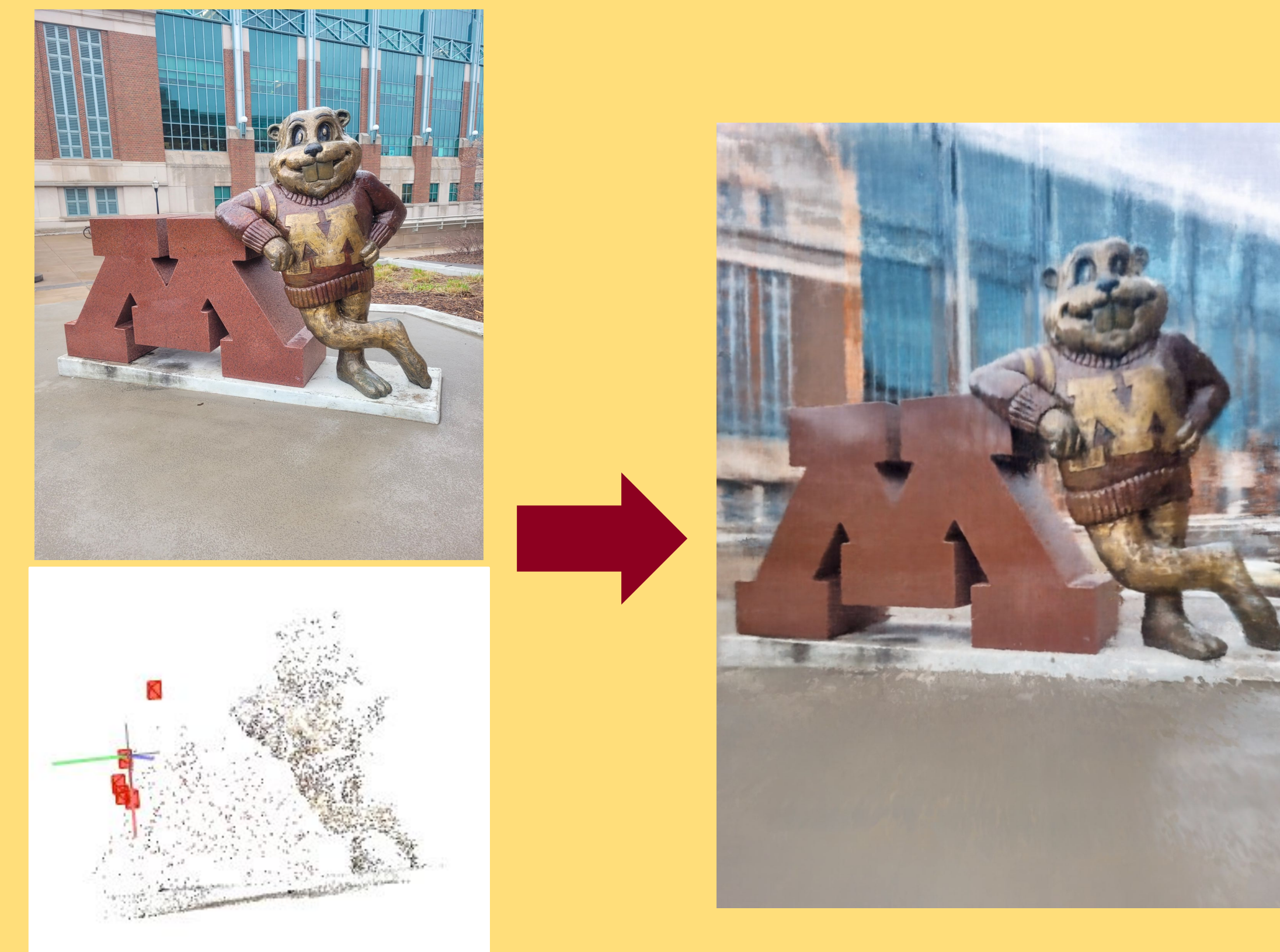
What we experimented on:

Dynamic Scene:
- No depth loss (None)
- DS loss only (DS)
- Single-view depth loss (SV)
- DS loss + Single-view depth loss (Mix)

Using a ***Depth-Supervised*** loss can reduce training time, even for rendering dynamic scenes.

Faster Training

The rendering quality on the entire scene

The rendering quality in dynamic regions only

Static View Synthesis

SV   Mix

Quantitative evaluation

Methods	Dynamic Only			Full		
	SSIM↑	PSNR↑	LPIPS↓	PSNR↑	SSIM↑	LPIPS↓
None	0.773	21.97	0.165	28.77	0.884	0.233
SV	0.748	21.00	0.179	28.79	0.888	0.220
DS	0.792	22.58	0.140	29.06	0.891	0.219
Mix	**0.801**	**23.02**	**0.126**	**29.25**	**0.898**	**0.205**

Update the COLMAP → Modify the data loader → Generate the rays for key points → Render the ray depths → Calculate Depth Supervised Loss

Depth-supervised NeRF: Fewer Views and Faster Training for Free, Deng et al., 2022
Neural Scene Flow Fields for Space-Time View Synthesis of Dynamic Scenes, Li et al., 2021

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