

NeRF for Real-time Rendering of Dynamic Scenes

Midterm Project Proposal

May 11, 2022

Team 5

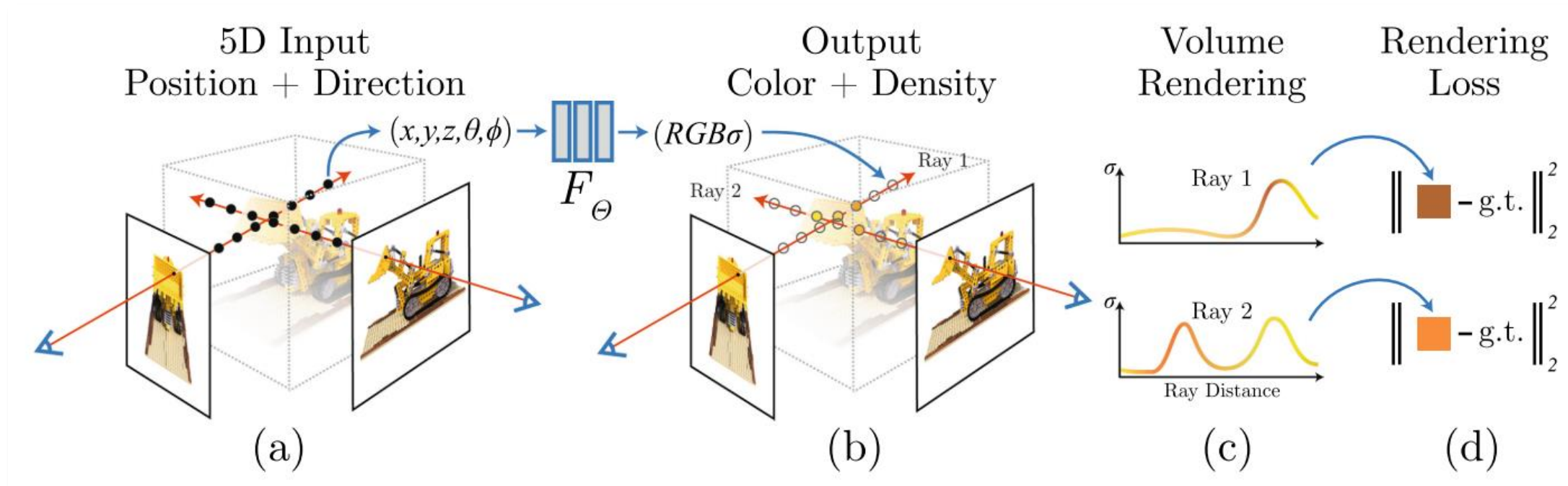
Contents

- I. Introduction
- II. Related Work
- III. Proposal

Introduction

Introduction

■ Recap on NeRF



Introduction

- **Limitations of NeRF**

- Training time
- Inference time
- Scalability
- Camera calibration
- Static scene

Introduction

- **Limitations of NeRF**

- Training time
- Inference time
- Scalability
- Camera calibration
- Static scene

Introduction

■ Why?

- How much time is needed for rendering 10-second scene with 60 fps?
 - NeRF: 30 seconds / frame
 - Rendering 600 frames will take 5 hours!



Related Work

Related Work

■ NeRF for Dynamic Scenes

- D-NeRF
- Nerfies
- Neural Scene Flow Fields
- ...

Pumarola et al. D-nerf: Neural radiance fields for dynamic scenes. CVPR 2021.

Park et al. Nerfies: Deformable neural radiance fields. ICCV 2021.

Li et al. Neural scene flow fields for space-time view synthesis of dynamic scenes. CVPR 2021.

Related Work

- **NeRF for Dynamic Scenes**
 - D-NeRF
 - Nerfies
 - Neural Scene Flow Fields
 - ...

Pumarola et al. D-nerf: Neural radiance fields for dynamic scenes. CVPR 2021.

Park et al. Nerfies: Deformable neural radiance fields. ICCV 2021.

Li et al. Neural scene flow fields for space-time view synthesis of dynamic scenes. CVPR 2021.

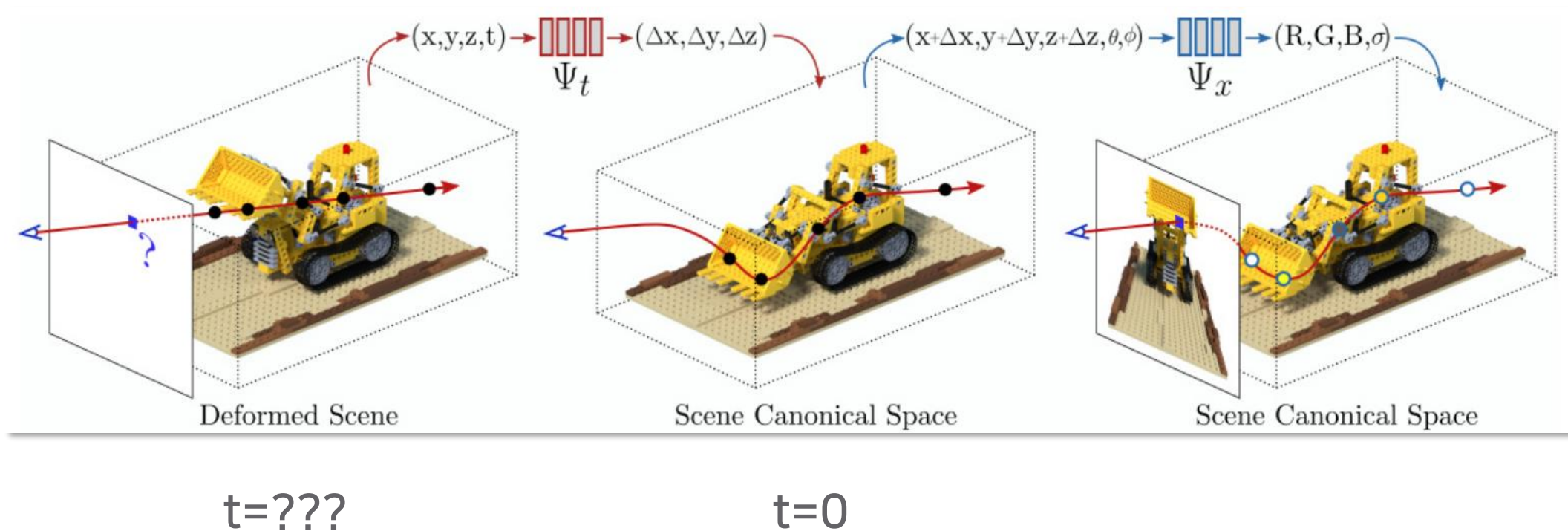
Related Work

- **D-NeRF**

- Main idea
 - 6D input: $(x, y, z, \theta, \phi) + t$
 - Factorization
 - › Deformation network
 - › Canonical network

Related Work

- D-NeRF
 - Factorization



Related Work

- **D-NeRF**
 - Limitations
 - No improvement in the rendering process

Related Work

■ NeRF for Fast Rendering

- KiloNeRF
- FastNeRF
- PlenOctrees
- Neural Graphics Primitives
- Mixture of Volumetric Primitives
- ...

Reiser et al. Kilonerf: Speeding up neural radiance fields with thousands of tiny mlps. ICCV 2021.

Garbin et al. Fastnerf: High-fidelity neural rendering at 200fps. ICCV 2021.

Yu et al. Plenoctrees for real-time rendering of neural radiance fields. ICCV 2021.

Lombardi et al. Mixture of volumetric primitives for efficient neural rendering. SIGGRAPH 2021.

Müller et al. Instant neural graphics primitives with a multiresolution hash encoding. SIGGRAPH 2022.

Related Work

■ NeRF for Fast Rendering

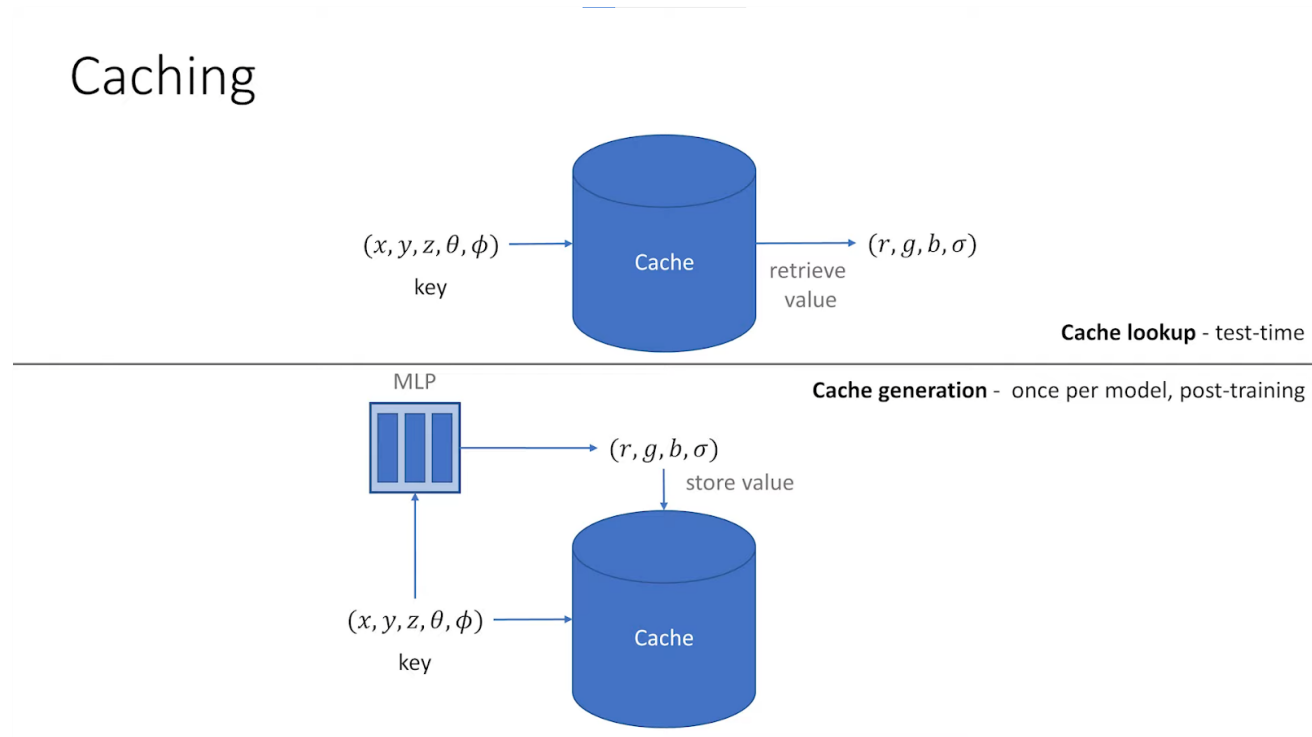
- KiloNeRF
- FastNeRF
- PlenOctrees
- Neural Graphics Primitives
- Mixture of Volumetric Primitives
- ...

Reiser et al. Kilonerf: Speeding up neural radiance fields with thousands of tiny mlps. ICCV 2021.
Garbin et al. Fastnerf: High-fidelity neural rendering at 200fps. ICCV 2021.
Yu et al. Plenoctrees for real-time rendering of neural radiance fields. ICCV 2021.
Lombardi et al. Mixture of volumetric primitives for efficient neural rendering. SIGGRAPH 2021.
Müller et al. Instant neural graphics primitives with a multiresolution hash encoding. SIGGRAPH 2022.

Related Work

■ FastNeRF

- Main idea
 - Test-time reduction by caching



Related Work

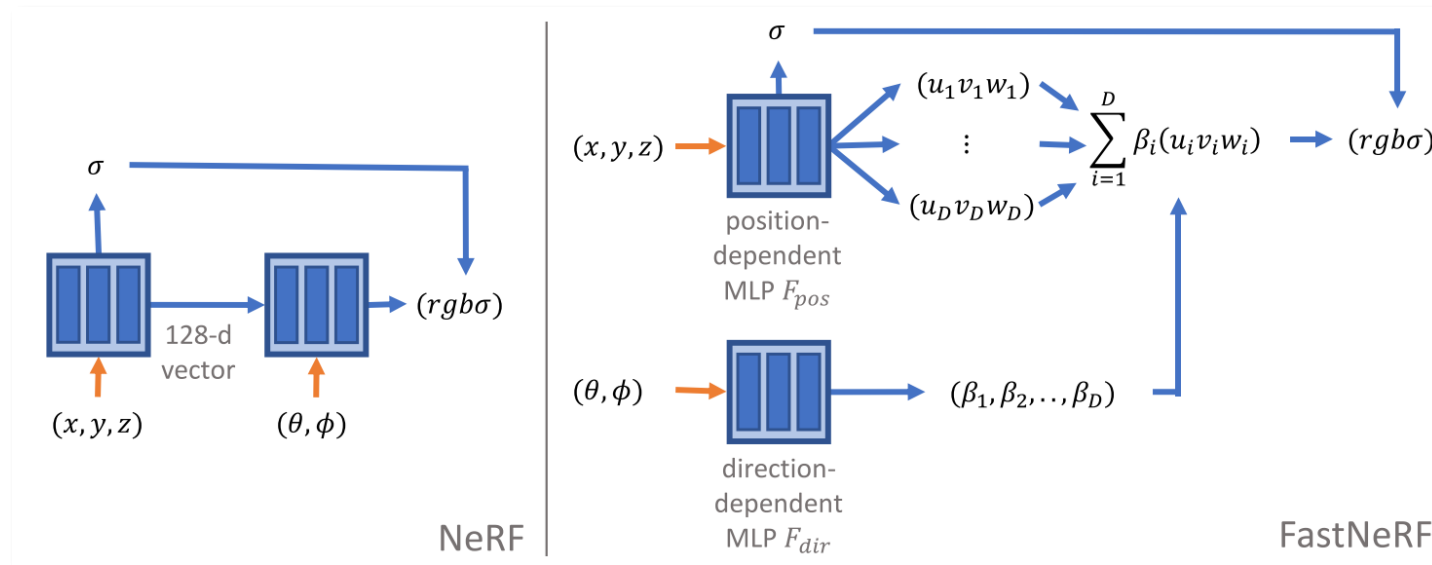
■ FastNeRF

- Main idea
 - Test-time reduction by caching
 - Problem
 - › $RGB = f(x, y, z, \theta, \phi)$
 - › Therefore, $O(N^5)$ memory is required
 - › 5600TB is required for 1024 cache resolution

Related Work

■ FastNeRF

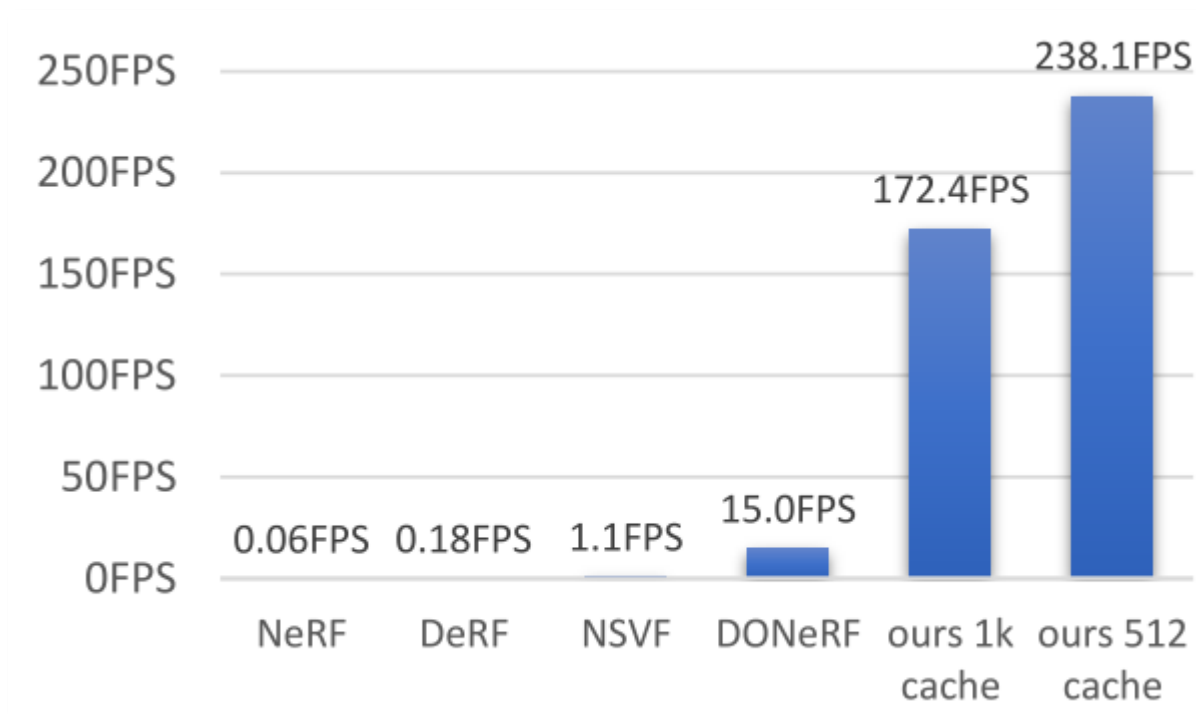
- Main idea
 - Factorization of NeRF
 - › Position-dependent network
 - › Direction-dependent network



Related Work

- **FastNeRF**

- Runtime performance



Related Work

■ FastNeRF

- Runtime performance

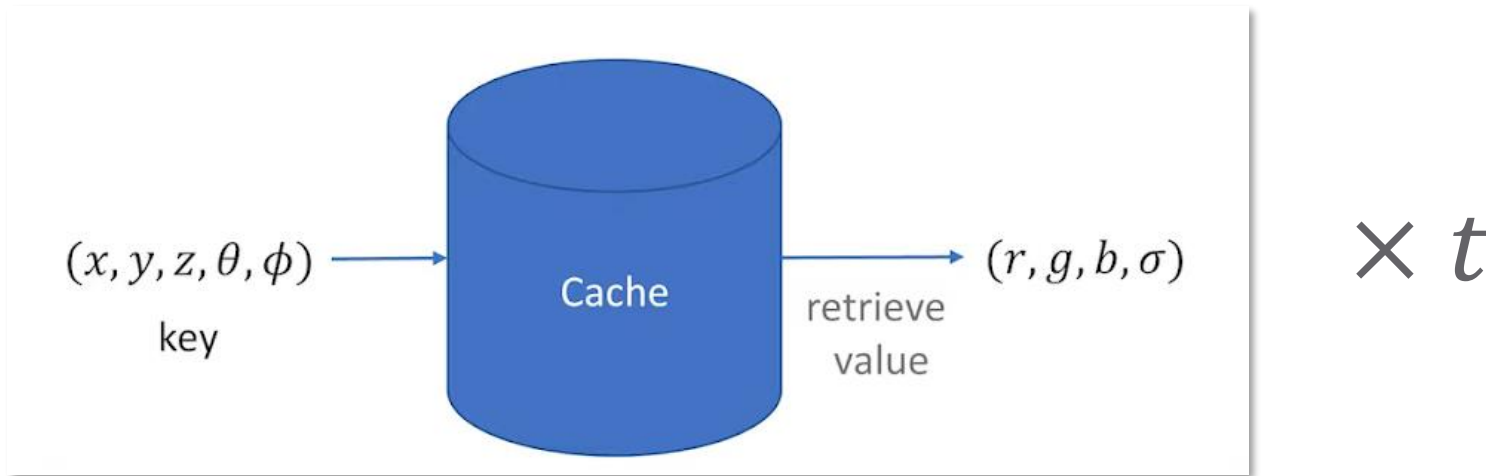
Factors	No Cache		256 ³		384 ³		512 ³		768 ³	
	PSNR↑	Memory	PSNR↑	Memory	PSNR↑	Memory	PSNR↑	Memory	PSNR↑	Memory
4	27.11dB	-	24.81dB	0.34GB	26.29dB	0.61GB	26.94dB	1.09GB	27.54dB	2.51GB
6	27.12dB	-	24.82dB	0.5GB	26.34dB	0.93GB	27.0dB	1.67GB	27.58dB	4.1GB
8	27.24dB	-	24.89dB	0.71GB	26.42dB	1.41GB	27.1dB	2.7GB	27.72dB	7.15GB
16	27.68dB	-	25.07dB	1.2GB	26.77dB	2.08GB	27.55dB	3.72GB	28.3dB	9.16GB

Proposal

Proposal

■ NeRF for Real-time Rendering of Dynamic Scenes

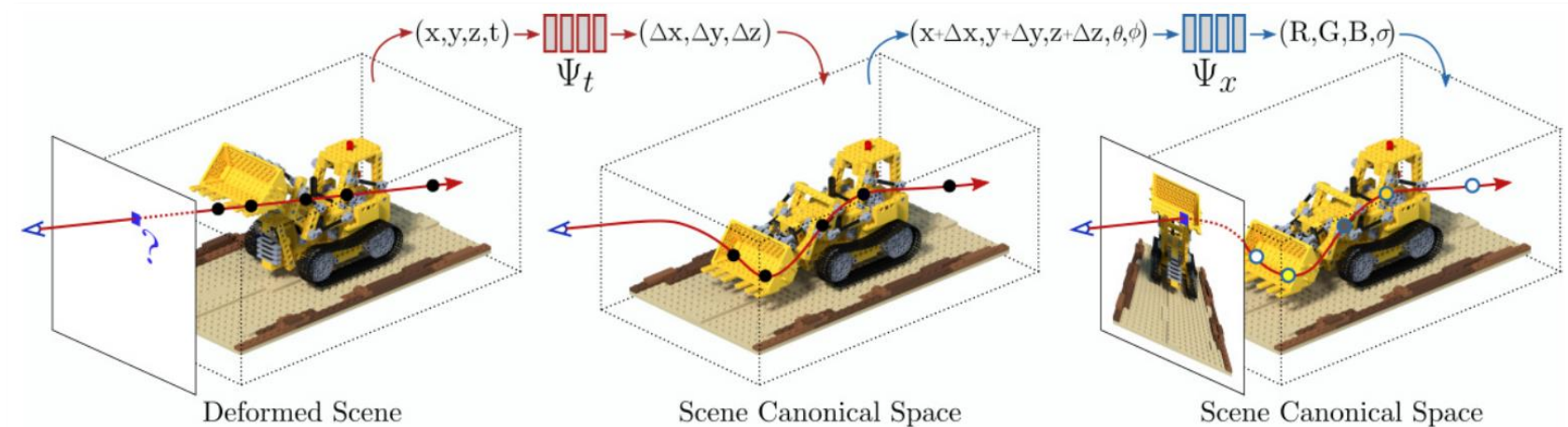
- Problem of caching in dynamic scenes
 - Memory requirement can be increased with respect to the time



Proposal

■ NeRF for Real-time Rendering of Dynamic Scenes

- Problem of caching in dynamic scenes
 - Memory requirement can be increased with respect to the time
 - However, deformation module can resolve this problem
 - › Same part between different time is mapped onto the same point by deformation network
 - › Then, the cached size does not have to be increased



Proposal

- **NeRF for Real-time Rendering of Dynamic Scenes**
 - Combination of each strength
 - Deformation module from D-NeRF
 - Caching from FastNeRF
 - Then, real-time rendering of dynamic scenes will be possible

Proposal

▪ Role

- Sangwon Kwak
 - Survey on NeRF for dynamic scenes
 - Dataset generation
- Seokhyeon Hong
 - Survey on NeRF for fast rendering
 - Training the network
- Common
 - Code integration
 - Result analysis and presentation

Q&A

Team 5