NeRF in the Wild: Neural Radiance Fields for Unconstrained Photo Collections

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Подготовил:
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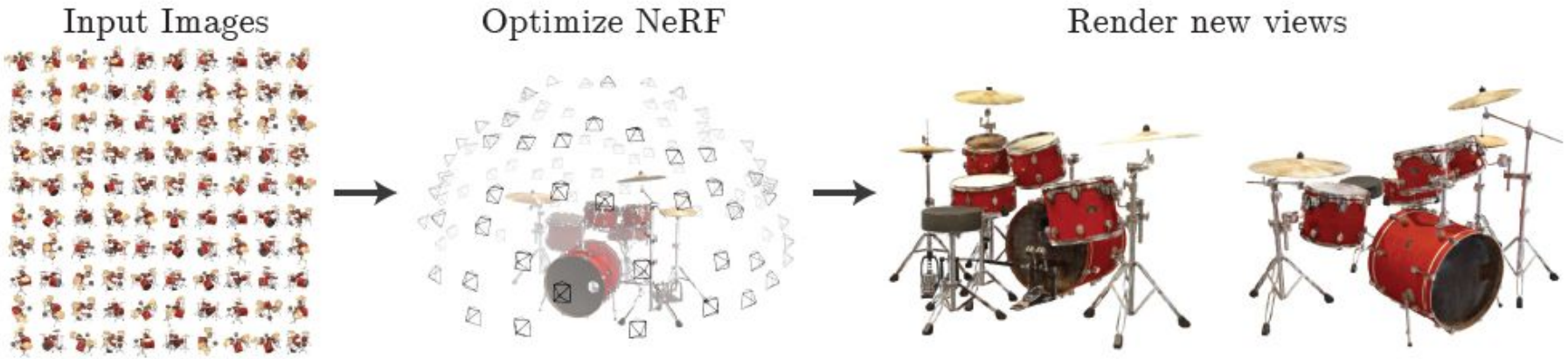
Plan

1. Task description: Novel View Synthesis.
2. NeRF.
3. Limitations of NeRF.
4. NeRF-W architecture.
5. Results.

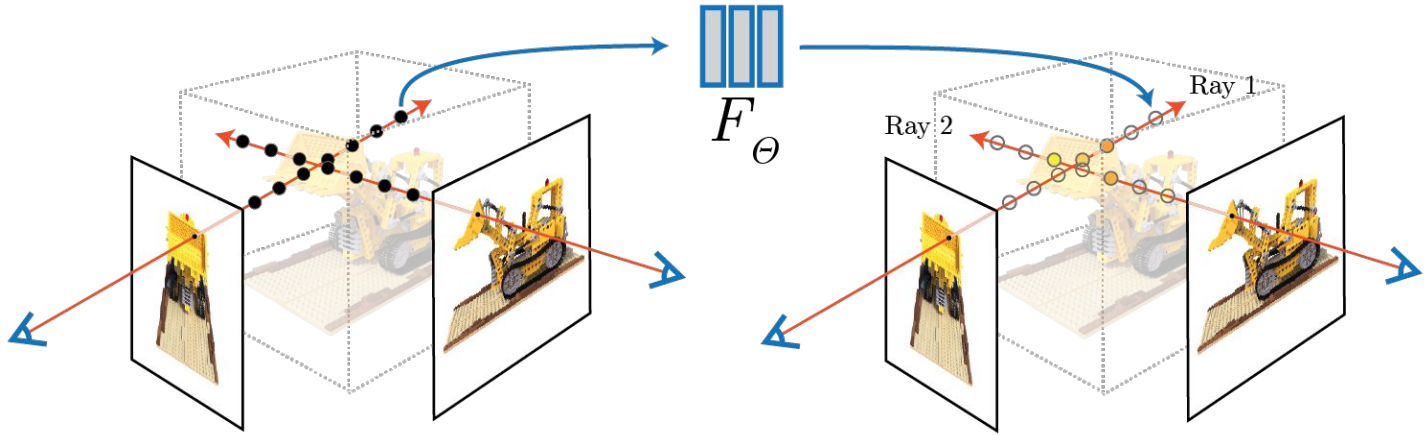
Novel View Synthesis

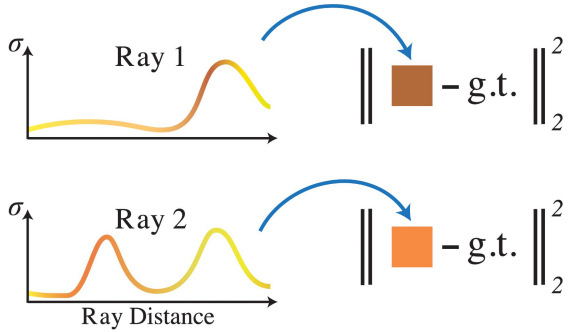


NeRF

$$(x, y, z, \theta, \phi) \rightarrow \boxed{\quad} \rightarrow (RGB\sigma)$$

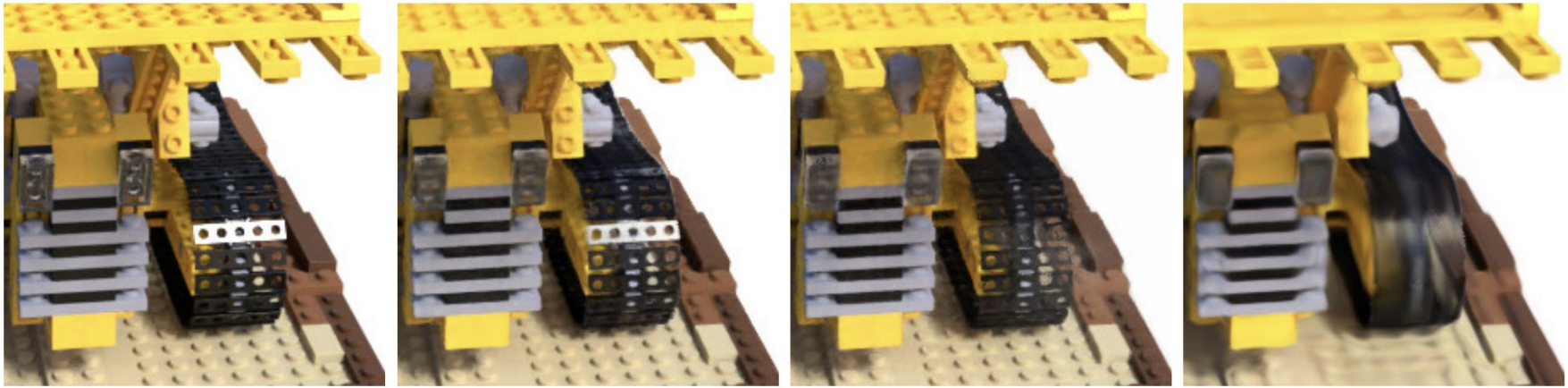
$$F_\Theta$$





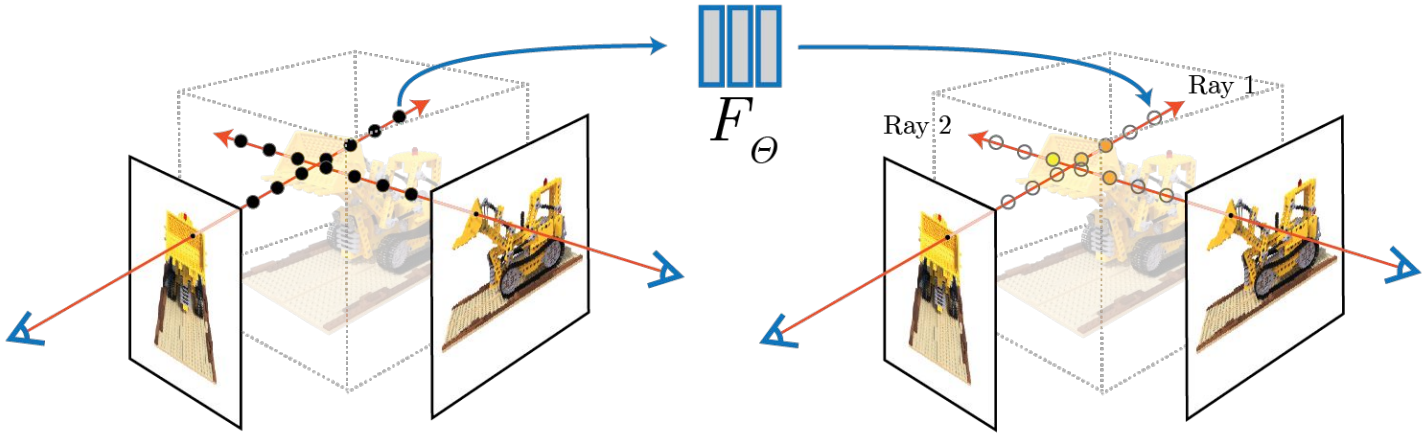
Positional encoding

$$\gamma(p) = \left(\sin\left(2^0\pi p\right), \cos\left(2^0\pi p\right), \cdots, \sin\left(2^{L-1}\pi p\right), \cos\left(2^{L-1}\pi p\right)\right)$$



Ground Truth | Complete Model | No View Dependence | No Positional Encoding

Coarse and Fine networks



$$\sum_{ij} \left\| \mathbf{C}(\mathbf{r}_{ij}) - \hat{\mathbf{C}}^c(\mathbf{r}_{ij}) \right\|_2^2 + \left\| \mathbf{C}(\mathbf{r}_{ij}) - \hat{\mathbf{C}}^f(\mathbf{r}_{ij}) \right\|_2^2, \quad (5)$$

where $\mathbf{C}(\mathbf{r}_{ij})$ is the observed color of ray j in image $\mathcal{I}_i$, and $\hat{\mathbf{C}}^c$ and $\hat{\mathbf{C}}^f$ are the coarse and fine models respectively.

NeRF results

NeRF limitations

- Work well in controlled settings (lighting effects remain constant, and all content in the scene is static).
- NeRF's performance degrades significantly when presented with moving objects or variable illumination.

Naively applying NeRF to in-the-wild photo collections results in inaccurate reconstructions that exhibit severe ghosting, oversmoothing, and further artifacts

NeRF-W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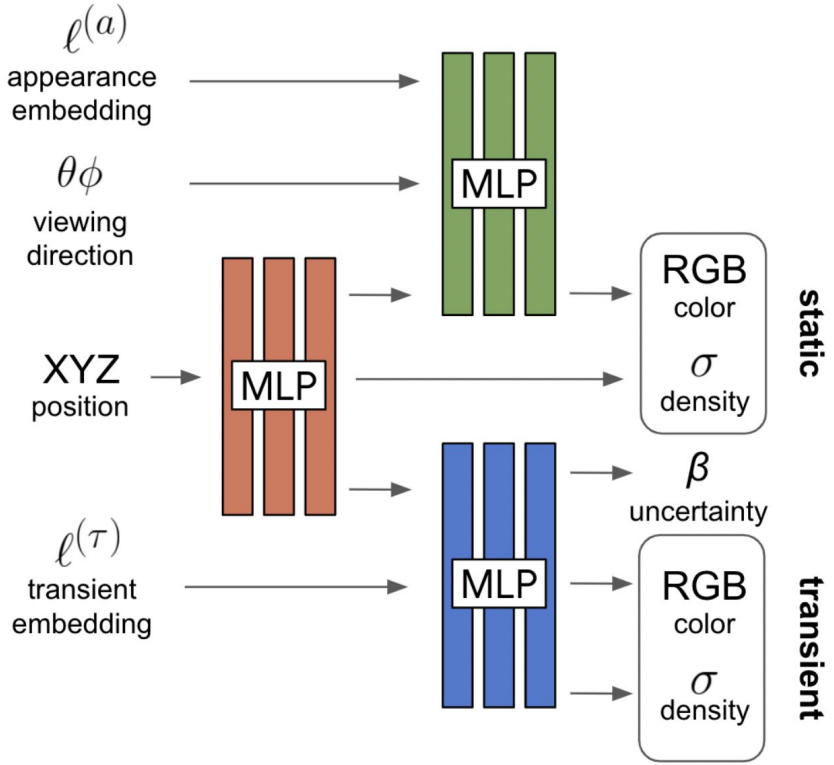
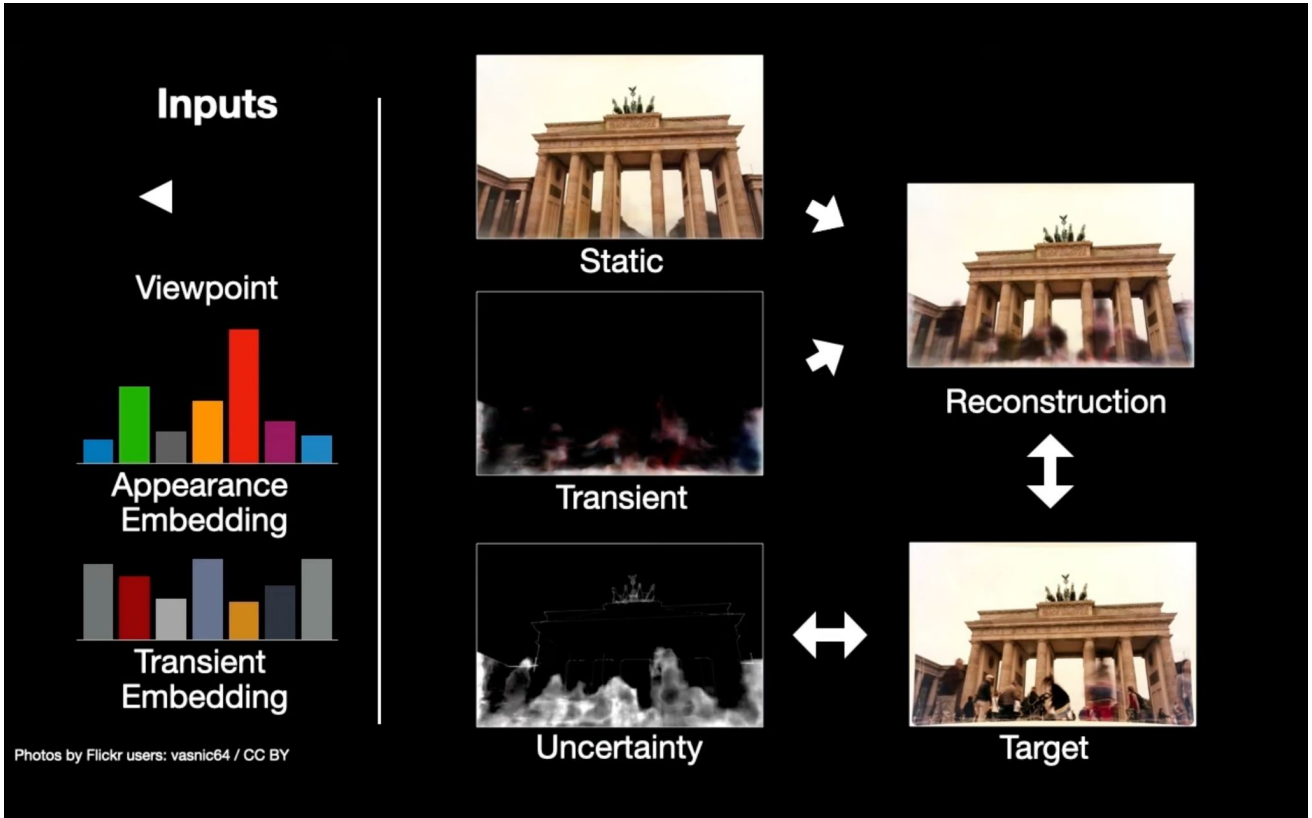
LATEINAMERIKA WURDE
NICHT ENTDECKT.
ES WURDE UND WIRD
BESETZT UND AUSGEPLÜNDERT

NeRF-W model architecture

1. **Photometric variation.**
2. **Transient objects.**



NeRF-W model architecture



NeRF-W experiments

Data: 6 landmarks from the Phototourism dataset (Trevi Fountain, Sacre Coeur, the Brandenburg Gate, Taj Mahal, Prague Old Town Square, and Hagia Sophia)

Baselines: NRW, NeRF, NeRF-A, NeRF-U

Metrics: PSNR, MS-SSIM, LPIPS

	Brandenburg Gate			Sacre Coeur			Trevi Fountain			Taj Mahal			Prague			Hagia Sophia		
	PSNR	MS-SSIM	LPIPS	PSNR	MS-SSIM	LPIPS	PSNR	MS-SSIM	LPIPS	PSNR	MS-SSIM	LPIPS	PSNR	MS-SSIM	LPIPS	PSNR	MS-SSIM	LPIPS
NRW [22]	23.85	0.914	0.141	19.39	0.797	0.229	20.56	0.811	0.242	21.24	0.844	**0.201**	19.89	0.803	**0.216**	20.75	0.796	**0.231**
NeRF	21.05	0.895	0.208	17.12	0.781	0.278	17.46	0.778	0.334	15.77	0.697	0.427	15.67	0.747	0.362	16.04	0.749	0.338
NeRF-A	27.96	0.941	0.145	24.43	0.923	0.174	26.24	0.924	0.211	25.99	0.893	0.225	22.52	0.870	0.244	21.83	0.820	0.276
NeRF-U	19.49	0.921	0.174	15.99	0.826	0.223	15.03	0.795	0.277	10.23	0.778	0.373	15.03	0.787	0.315	13.74	0.706	0.376
NeRF-W	**29.08**	**0.962**	**0.110**	**25.34**	**0.939**	**0.151**	**26.58**	**0.934**	**0.189**	**26.36**	**0.904**	0.207	**22.81**	**0.879**	0.227	**22.23**	**0.849**	0.250

NeRF Results

NeRF-W results

NeRF-W results

NeRF-W limitations

1. Rendering quality degrades in areas of the scene that are rarely observed in the training images, or only observed at very oblique angles.
2. NeRF-W is also sensitive to camera calibration errors, which can lead to blurry reconstructions on the parts of the scene that have been imaged by incorrectly-calibrated cameras.

Questions

1. Какие основные ограничения NeRF преодолеваются с помощью NeRF-W?
2. Что NeRF-W принимает в качестве входных данных?
3. Какие выходные данные у NeRF-W?

Useful Links

- NeRF paper https://arxiv.org/pdf/2003.08934.pdf
- NeRF page https://www.matthewtancik.com/nerf
- NeRF in the Wild paper https://arxiv.org/pdf/2008.02268.pdf
- NeRF in the Wild page https://nerf-w.github.io/
- NeRF explanation https://www.youtube.com/watch?v=CRlN-cYFxTk&ab_channel=YannicKilcher
- NeRF-W presentation https://www.youtube.com/watch?v=mRAKVQj5LRA&ab_channel=NeRF-W