

Quality Evaluation of Neural Radiance Field

Onuoha Chibuike Martins(d8252106) supervised by Prof. Truong Cong Thang



Introduction

Neural Radiance Field (NeRF) is attracting a lot of attention due to its robustness in synthesizing photorealistic views of complex scenes. NeRF is a technique that represents a scene as a continuous 3D function of color and intensity at any point in space [1]. Presently, it is investigated in areas such as robotics, digital entertainment and 3D graphics, and urban environment, etc. In virtual reality applications, NeRF can be used to create immersive content such as the reconstruction of human avatars and articulated body parts.

Motivation

Which quality metric is good for NeRF?

Research Objective

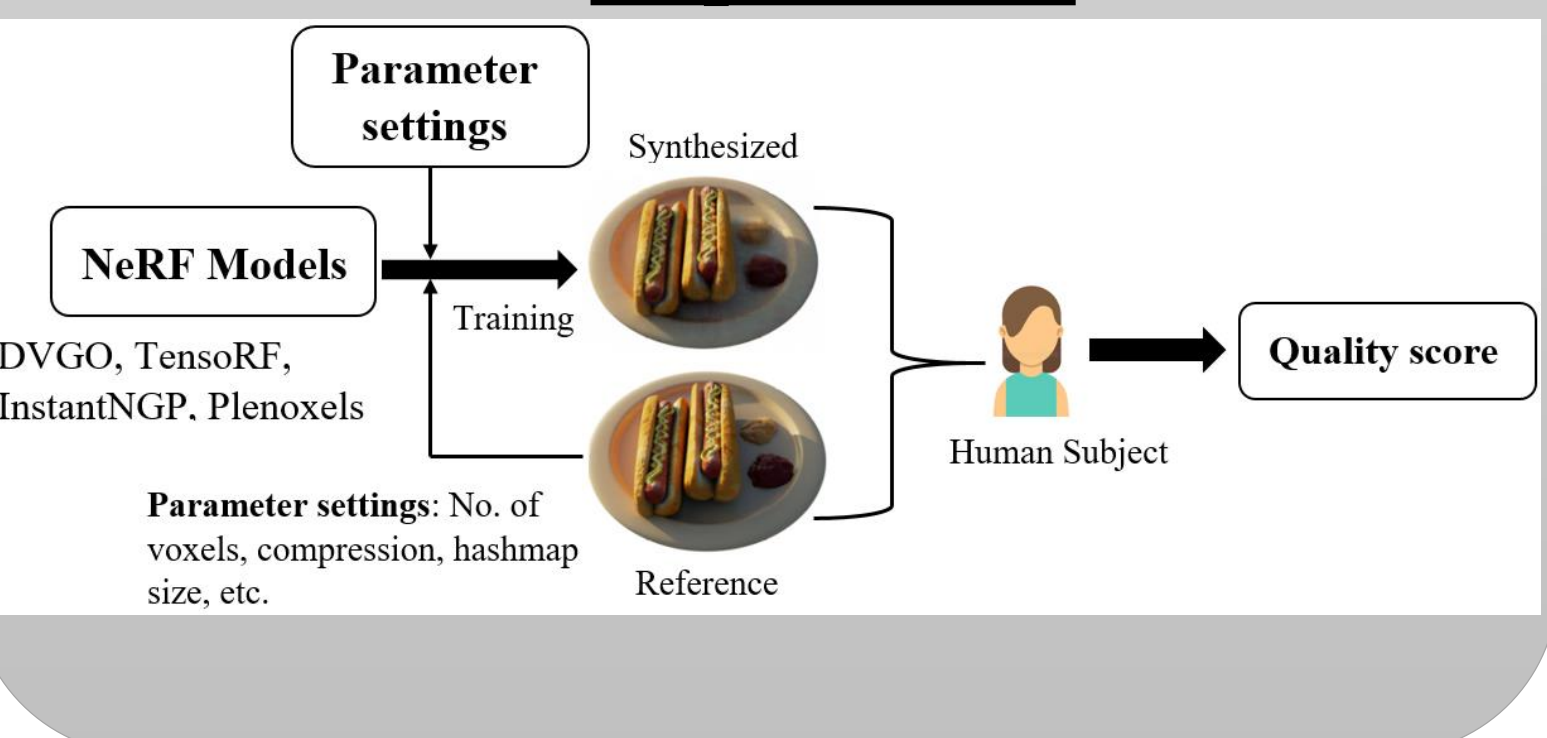
- To conduct a subjective and objective quality assessment.

Subjective Experiment

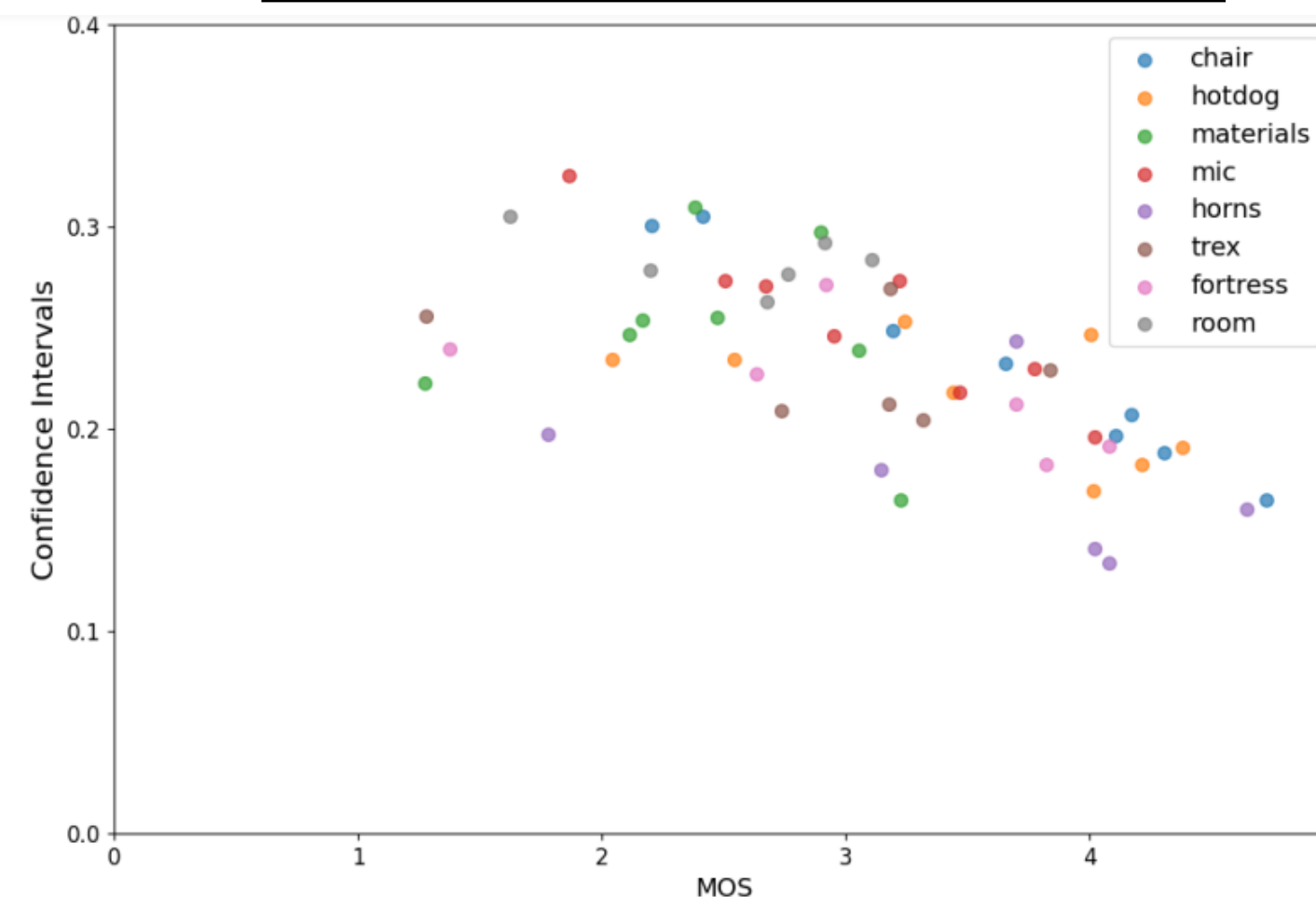
Our dataset contains 56 NeRF stimuli. The following are the requirement for the test:

- We require subjects to have a laptop/desktop with 2K (2560 x 1440 pixels) display size and advise them not to resize the viewing window.
- We also provide two video tutorials on how to view the image sequences on Macintosh and Windows OS.
- The standard test approach is DSIS method as defined by **ITU-R BT500-15**.
- Subjects are asked to rate the image sequences on a scale of 0 to 10 using the 11-point absolute category rating (ACR) scale.

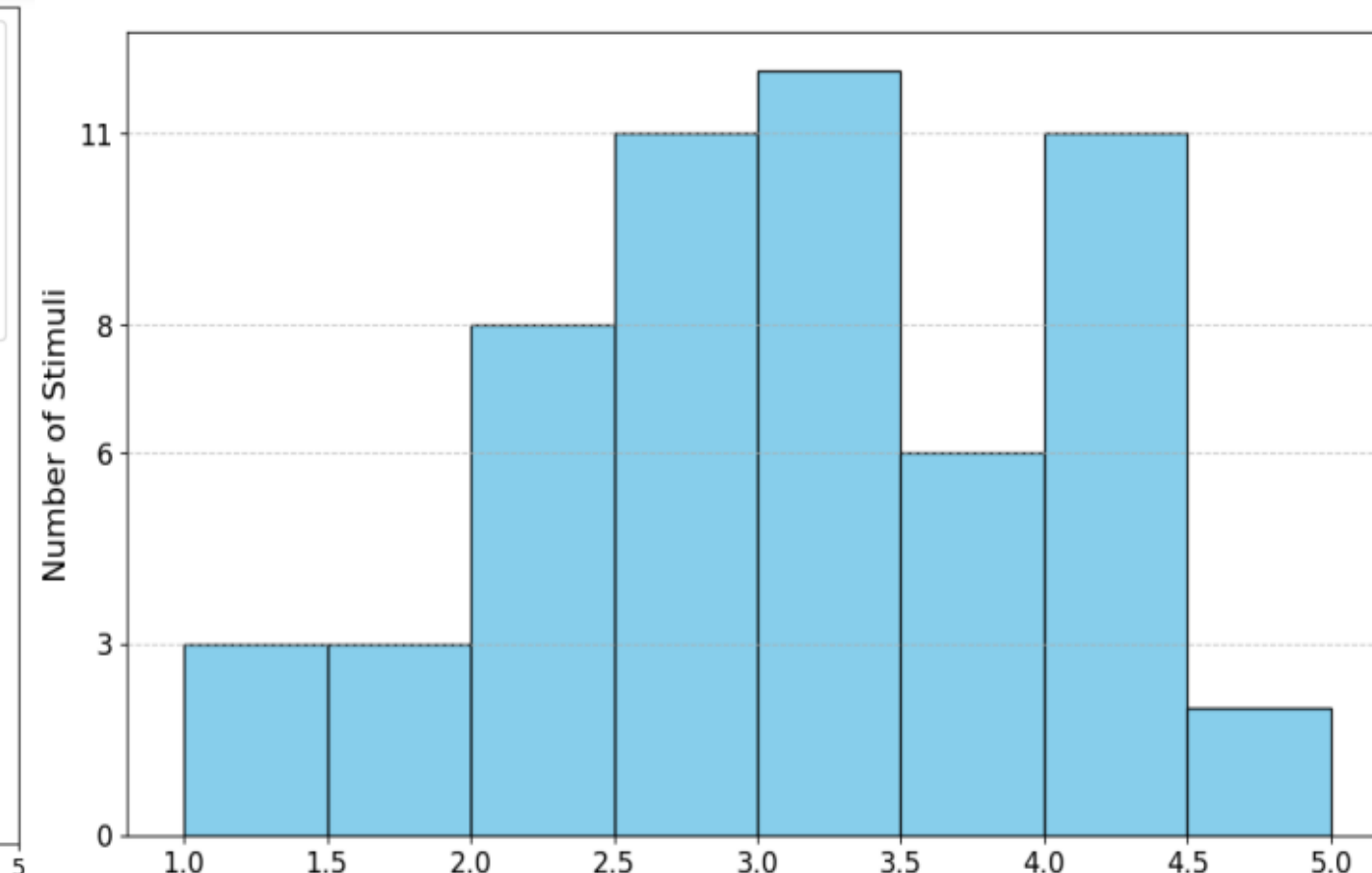
An Overview of Our Subjective Experiment



95% Confidence Interval



Distribution of MOS Scores



Stimuli in our dataset with low and high MOS score



Chair from TensorRF (MOS): 4.7265

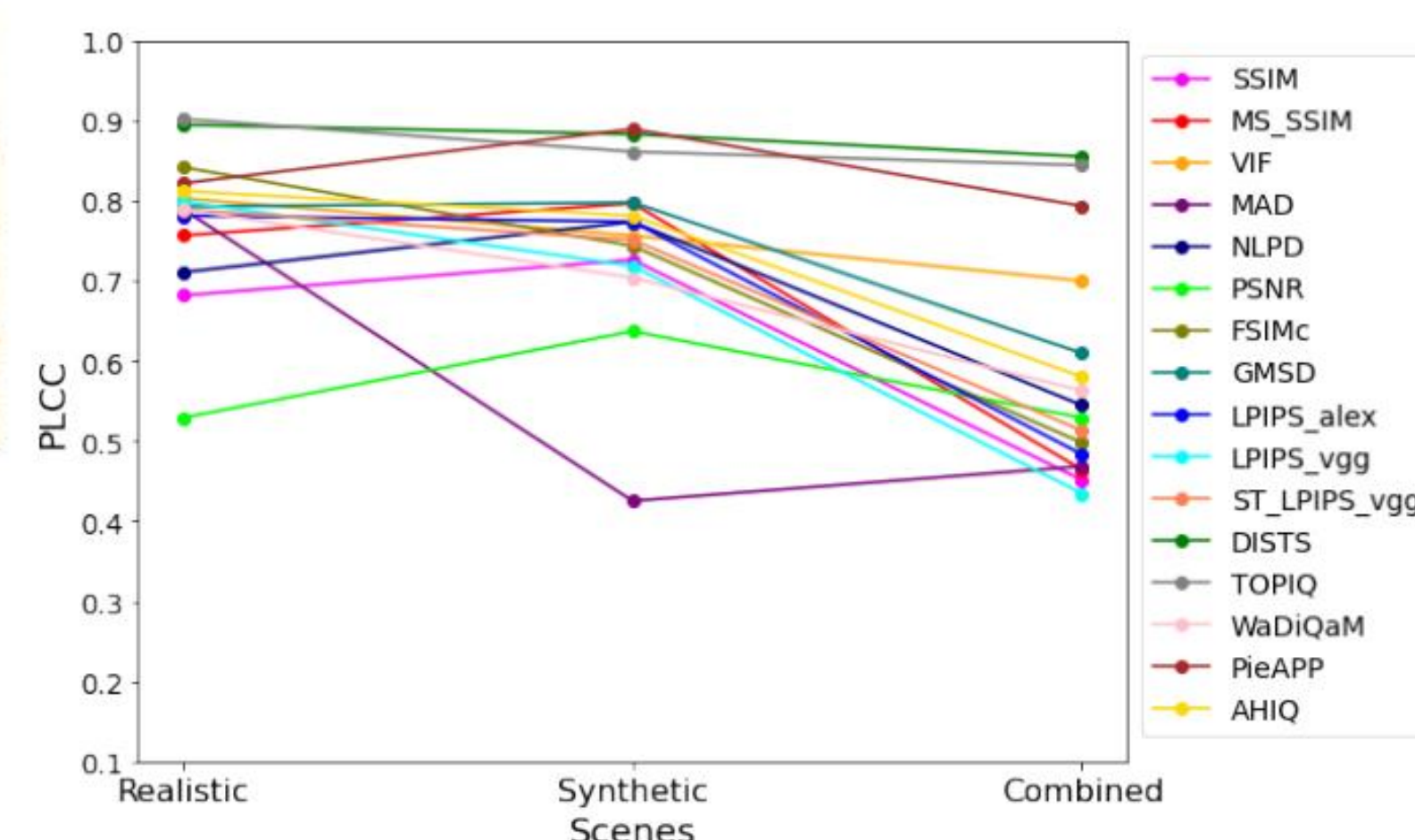
Trex from DVGO (MOS): 1.2809



Performance of Objective Quality Metrics

METRICS	REALISTIC SCENES			SYNTHETIC SCENES			COMBINED SCENES		
	PLCC [†]	SROCC [†]	KROCC [†]	PLCC [†]	SROCC [†]	KROCC [†]	PLCC [†]	SROCC [†]	KROCC [†]
SSIM	0.6818	0.3435	0.2536	0.7264	0.7042	0.5403	0.4515	0.3615	0.2792
MS-SSIM	0.7568	0.6139	0.4855	0.7969	0.7394	0.6290	0.4642	0.4511	0.3416
VIF	0.8032	0.6548	0.5290	0.7566	0.6928	0.5524	0.7000	0.6823	0.5156
MAD	0.7894	0.7252	0.5362	0.4254	0.3581	0.2621	0.4686	0.4161	0.2948
PSNR	0.5293	0.4806	0.3333	0.6371	0.6656	0.5000	0.5293	0.4806	0.3506
NLPD	0.7108	0.4922	0.3696	0.7737	0.6785	0.5363	0.5447	0.4137	0.3026
FSIMc	0.8418	0.7443	0.5942	0.7438	0.6661	0.5121	0.4980	0.4741	0.3364
GMSD	0.7927	0.6583	0.5145	0.7980	0.7401	0.6250	0.6097	0.5378	0.4091
LPIPS(alexNet)	0.7815	0.6835	0.5290	0.7739	0.7577	0.5605	0.4836	0.4319	0.3143
LPIPS(vgg16)	0.7992	0.7113	0.5434	0.7187	0.6785	0.5136	0.4348	0.4016	0.2961
ST-LPIPS(vgg16)	0.7889	0.5704	0.4130	0.7513	0.7339	0.5363	0.5132	0.4088	0.2935
DISTS	0.8949	0.8548	0.7246	0.8832	0.8658	0.6895	0.8552	0.8615	0.6844
TOPIQ	0.9021	0.8652	0.6739	0.8613	0.8702	0.7339	0.8443	0.8413	0.6688
WaDiQaM-FR	0.7894	0.6139	0.4637	0.7041	0.6697	0.5081	0.5629	0.5573	0.3935
PIEAPP	0.8219	0.6626	0.5362	0.8895	0.8831	0.7218	0.7935	0.7725	0.5909
AHIQ	0.8122	0.6504	0.4855	0.7815	0.7305	0.5847	0.5802	0.4883	0.3545

Performance of objective metrics (Visualization)



In Table 1 (**Combined scenes**), DISTS and TOPIQ are the best metrics with PLCC values of 85.52% and 84.43% respectively. Metrics such as DISTS and TOPIQ could effectively detect the distortions present in the test stimuli due to their prior knowledge. TOPIQ and DISTS quality metrics are the best on **realistic scenes**. TOPIQ metric yields a PLCC value of 90.21% and SROCC value of 86.52%. DISTS is the second best metric with a PLCC value of 89.49% and SROCC value of 85.48%. On the **synthetic scenes**, DISTS and PieAPP are the best quality metrics.

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