Comparison

Abstract

Comparison between 0002_Volume Rendering of Neural Implicit Surface and 0005_NeRF.

NeRF and Volume Rendering of Neural Implicit Surface (VN)

The reason I put them together is their tasks are similar, which is novel view synthesis. Recall the **expected color** expression in NeRF is:

$$C(\mathbf{r}) = \int_{t_n}^{t_f} T(t)\sigma(\mathbf{r}(t))\mathbf{c}(\mathbf{r}(t),\mathbf{d})dt,$$

where

$$T(t) = exp(-\int_{t_n}^{t} \sigma(\mathbf{r}(s))ds)$$

Therefore, the value of $C(\mathbf{r})$ is only relevant with σ and $\mathbf{c}$, and the values of $\mathbf{r}(t)$ and $\mathbf{d}$ are always known. Both focus on proposing new expression for σ and $\mathbf{c}$ (or L in VN) and sampling method.

In NeRF, σ is directly calculated from MLP.

In VN, σ is calculated by the CDF of Laplace distribution applied to a signed distance function.

In NeRF, $\mathbf{c}$ is also calculated from MLP. Recall $F_\Theta : (\mathbf{x},\mathbf{d}) \rightarrow (\mathbf{c},\sigma)$.

In VN, $L(\mathbf{x},\mathbf{n},\mathbf{v})$ or $\mathbf{c}$ is calculated from MLP, and $\mathbf{v}$ here is the same as $\mathbf{d}$ in NeRF. Level-set's normal $\mathbf{n}(t) = \nabla_{\mathbf{x}} d_\Omega(\mathbf{x}(t))$ is also considered in L.

In NeRF, hierarchical volume sampling: coarse and fine.

In VN, based on characteristics of density function they propose, concluding opacity approximation error and introducing