**Non-uniform Sampling Strategies for NeRF on 360° images**

**Background**

Novel view synthesis for 360° images in ERP format with NeRF

- Neural Radiance Fields (NeRF) [1]
  - Sample 2D pixels with equal probability to get 3D points along the ray
  - Feed 5D input into an MLP to produce a color and density
  - Use classical volume rendering techniques to accumulate those colors and densities
  - Minimize the squared error between the synthesized color and the ground truth color

**Method**

- **distortion-aware ray sampling**
  - Take into consideration the spatial distortion, the higher sampling probability are assigned to lower-latitude regions
  - The lower sampling probability are assigned to the higher-latitude regions

- **content-aware ray sampling**
  - Take into consideration the reconstruction loss of each pixel, the higher sampling probability are assigned to higher-texture regions
  - The lower sampling probability are assigned to lower-frequency regions

**Experiments**

Effect of each sampling strategy

- Replica Dataset
  - NeRF, NeRF, Ours, Ours, Ours, Ours

- SceneCity
  - NeRF, NeRF, Ours, Ours, Ours

**Problems with 360° image NeRF**

**Spatial distortion**

The uniform sampling strategy theoretically becomes problematic as the 3-D coverage of each ray passing through each pixel is not uniform due to the projective distortion.

- Indoor Scene
  - NeRF, NeRF, Ours, Ours

**Wide viewing angle**

It is wasteful to keep spending the same amount of learning resources to the low-frequency texture regions as are spent on the high-frequency textured regions.

- Outdoor Scene
  - NeRF, NeRF, Ours, Ours

**Synth360**

Create synthetic datasets Synth360 without camera parameter errors

- Replica Dataset [2]
- SceneCity [3]

**References**