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Theoretical Exercise 6

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This is the sample solution.

Exercise 1 NeRF Volume Ray Casting

Perform volume ray casting for the following ray samples evaluated by the NeRF network. The sample segments are given ordered by their distance to the camera position, meaning 1 is the sample closest to the camera. Assume a length of the sample segements of 0.1. Compute for:
$\sigma_3 = 0.0, RGB_1 = (0.0, 0.0, 0.0)$
$\sigma_1 = 10, RGB_1 = (1.0, 0.0, 0.0)$
$\sigma_2 = 3, RGB_1 = (1.0, 1.0, 0.0)$
$\sigma_4 = 1000, RGB_1 = (1.0, 0.0, 1.0)$
$\sigma_5 = 1000, RGB_1 = (1.0, 1.0, 1.0)$

Solution

alpha values: compute as $1.0 - e^(- (sigma * length))$
$\alpha_1 = 0.0$
$\alpha_2 = 0.63$
$\alpha_3 = 0.26$
$\alpha_4 = 1.0$
$\alpha_5 = 1.0$

$w_1 = 0.0$
$w_2 = (1.0 - cumprod(w_i, i \in [0])) * \alpha_2 =$

Exercise 2 NeRF Architecture

Argue for or against the following architecture choices for a NeRF:
a) Convolutions
b) Introducing direction in the first layer of the NeRF already
c) Training a (MIP) NeRF on multiple resolutions of the same image
d) Training KiloNeRF directly, not through distillation
e) Using leaky ReLus everywhere in the NeRF

Solution

a) basically, every sample is handled by same MLP −¿ conv with kernelsize=1 if you want to; otherwise, BS; we dont every compute directly on an image
b) bad, introduces ghosting - direction-dependant geometry is a bad idea
c) good idea, can do; more data = better! makes better use of that helps to learn a better function
d) introduces ghosting: every NeRF itself wants to solve −¿ they all learn some geometry. Test −¿ broke!
e) great idea - NOT for density though!