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A Neural Reconstruction Method for Non-Line-of-Sight Imaging

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MOTIVATION

Non-Line-of-Sight Imaging (NLOS) is a research field targeted to capture a scene which is not directly visible from the direct line-of-sight of a camera [1]. It exploits time-resolved measurements to disambiguate diffuse light paths and estimate the time-of-flight of photon counts, so as to effectively **see around corners**. Recovering information of hidden scenes has promising potential in society to make medical surgery less invasive, or to improve the safety of autonomous driving vehicles.

Under this description, NLOS is an **inverse problem**. It uses computational assets to estimate by the output of a sensing system the hidden geometry of an obscured scene. Like other inverse problems, data-driven methods have been adopted to approach NLOS and represent the hidden geometry in the weight values of **a deep neural network**.

This work leverages the use of a deep neural network to accomplish reconstruction in NLOS. This neural model will provide a **coordinate-dependent representation** of the hidden scene, achieving smooth reconstructions independent of the imaging plane.

METHOD

We choose a neural model based on Neural Radiance Fields (NeRF) from the literature [2, 3]. It is based on a MLP with ReLU activation functions. The imaging pipeline of the scene is decoupled from training, so the network is optimized with the transient response.

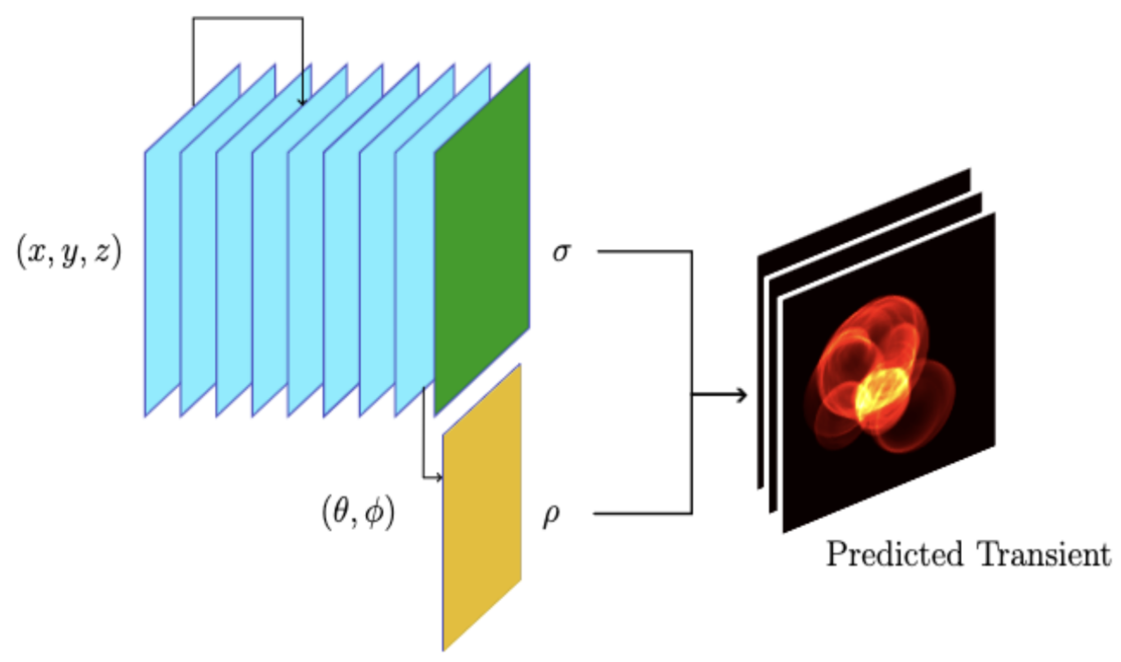

Figure 1. NeRF-like neural model consisting of a MLP used in the view synthesis method for Non-Line-of-Sight Imaging. Equal-colored layers share the same settings. All layers are fully-connected with each other, and the output consists of opacity and albedo functions describing the scene.

RESULTS

The coordinate-based representation of the Lambertian hidden scene enables the simulation of a **virtual camera**. By implementing a camera model it is possible to render novel views of the illuminated surface of the hidden scene.

Ground truth View 1 Front View 2

Time-of-flight methods [4] reconstruct subject to the imaging plane of the transient capture. The neural model conditioned to the NeRF 5D light field permits imaging from other reference systems to view **the visible reconstruction space**.

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