Non-Line-of-Sight Transient Rendering

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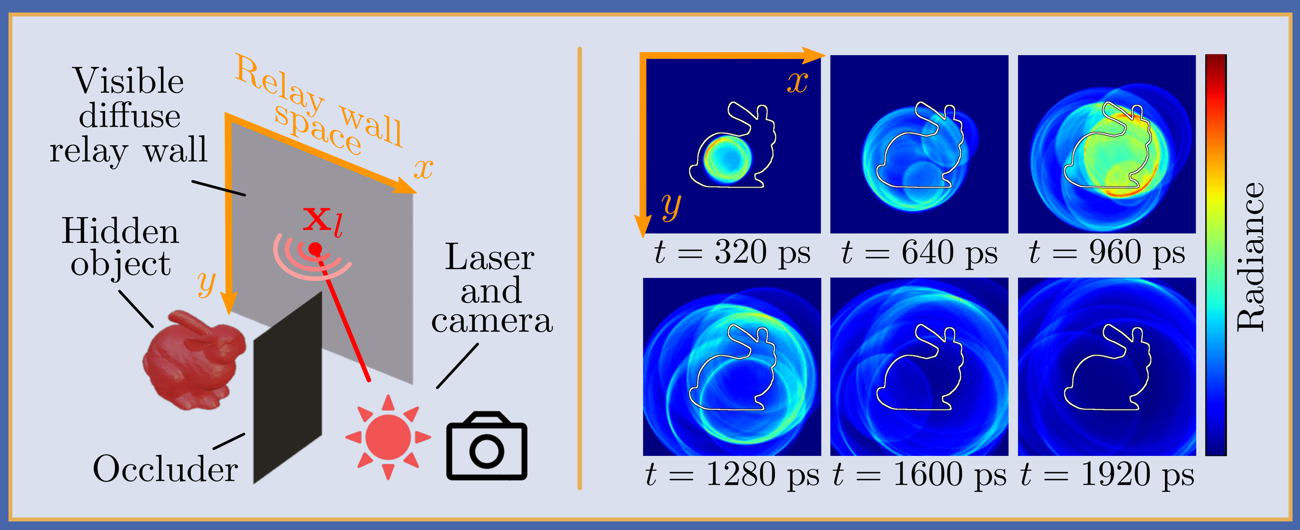
PROBLEM

Non-line-of-sight (NLOS) imaging allows to look **around corners** by analyzing time-resolved indirect diffuse reflections through a secondary wall.

Measurements require **expensive hardware** such as **pulsed illumination** and **ultra-fast sensor devices** with picosecond resolution, difficult to operate.

Transient light transport simulation emerges as an alternative tool to develop new applications. However, conventional path tracing algorithms are sub-optimal for NLOS, as the light and camera indirectly aim at geometry from a secondary wall.



RELATED WORK

Some of the existing NLOS simulation methods are limited to **three-bounce paths** [1, 2, 8], and thus ignore interreflections in the geometry.

Bidirectional path tracing [3] and **ellipsoidal path connections** [7] can be improved by targeting specific configurations of NLOS scenes.

OUR APPROACH

We develop three subpath sampling strategies that leverage the typical configuration of NLOS scenes to **reduce the path integration space**.

Simulating longer paths could allow to tackle problems such as **looking around two corners**.

We incorporate our sampling strategies in the **Mitsuba 2 rendering system** [6], with advantages such as CPU/GPU parallelization or possible support for light polarization and differentiable rendering.

Code is publicly available[1], and works for both line-of-sight and non-line-of-sight scenes.

[1] https://github.com/diegoroyo/mitsuba2-transient-nlos

METHOD

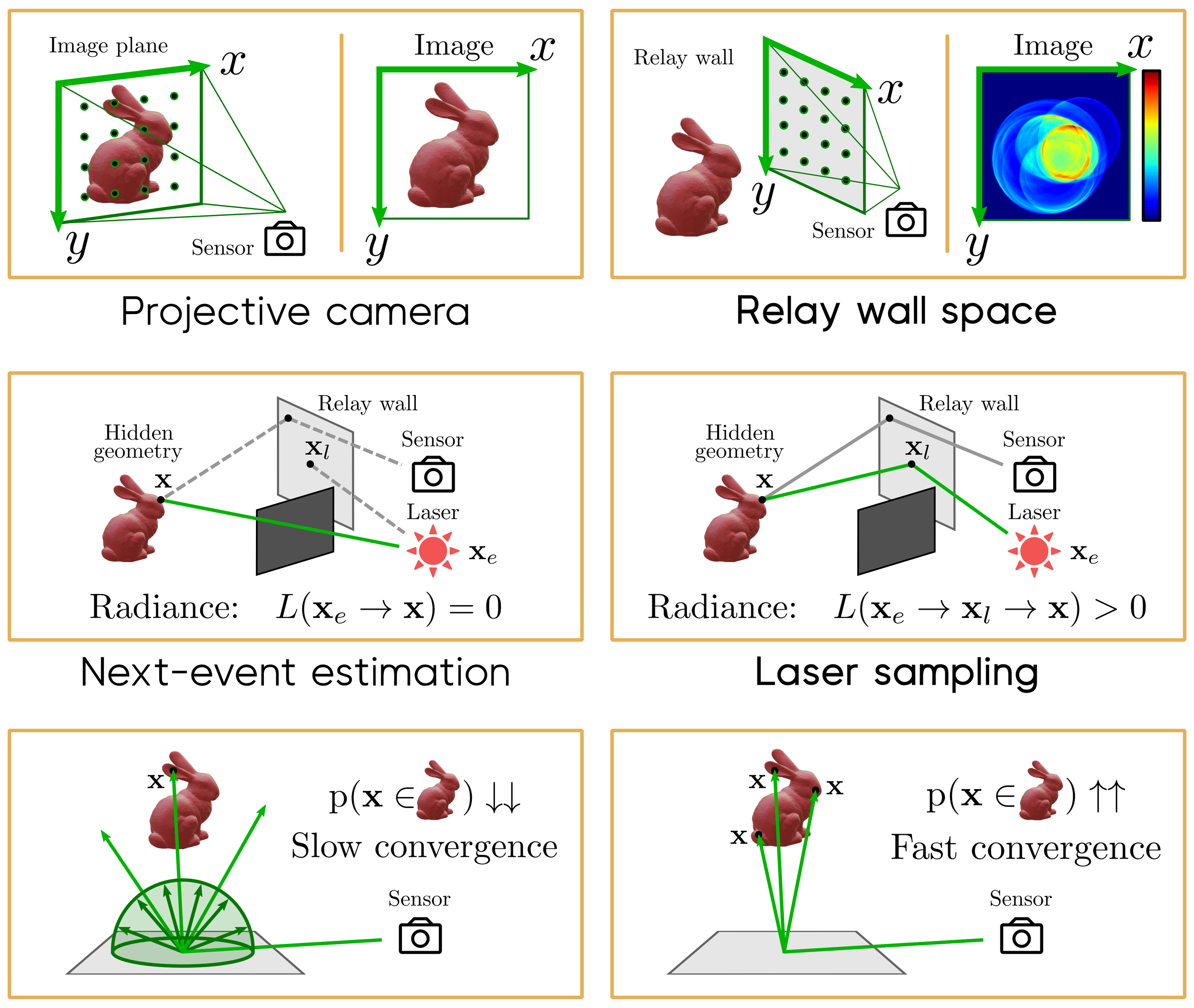
We introduce **three subpath sampling techniques** that extend the transient path integral formulation for light transport simulation by Jarabo et al. [4]:

Challenges of non-line-of-sight scenes:

1) Sensor measures the light coming from a differential solid angle over sparse points on a visible wall

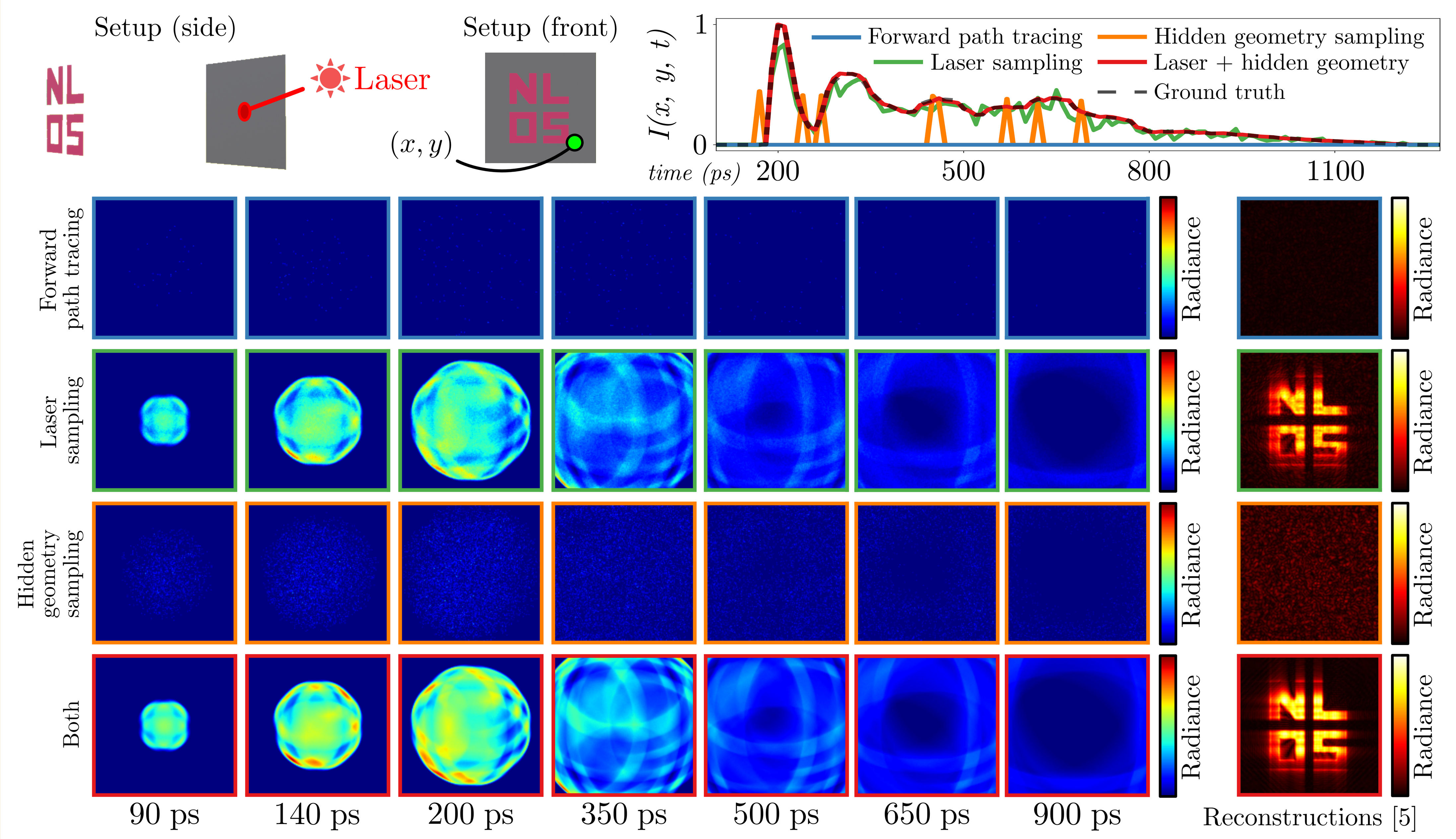
2) Light emits on a differential solid angle illuminating a single point on the visible wall

3) Path vertices need to be sampled on the hidden geometry to contribute to the result

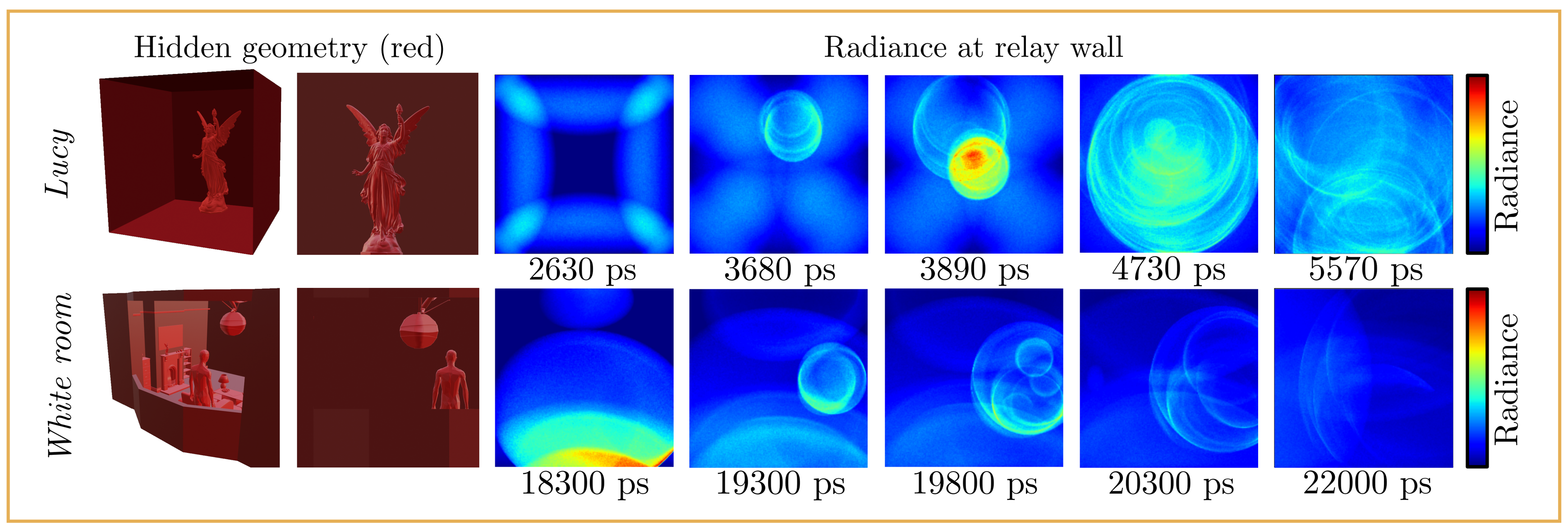


RESULTS

Convergence is faster by two orders of magnitude with equal render times:



Implementation in Mitsuba 2 allows to render complex scenes efficiently:



Code for Mitsuba 2

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