OBSERVER

OBSERVER

Wave domain, spatial domain, gradient-based

OBSERVER

Impulse response function $H(\mathbf{x}_l, \mathbf{x}_s, t)$

$\times$ S SPAD positions $\mathbf{x}_s$

Transport at wall


Transport at wall
0 ns
time (T bins)
40 ns

Transport at wall

Transport at wall

Size: $L \times S \times T$

Transport at wall

[La Manna et al. 2018]

PROBLEM: Spatial ambiguities

PROBLEM: Spatial ambiguities

$$f(\mathbf{x}_v) = \iint_{S\,L} H'(\mathbf{x}_l, \mathbf{x}_s, t_{lv} + t_{sv})\, d\mathbf{x}_l\, d\mathbf{x}_s$$

$$H' = H * K$$

transport to the hidden scene

$$f(\mathbf{x}_v) = \int\limits_S \int\limits_L H'(\mathbf{x}_l, \mathbf{x}_s, t_{lv} + t_{sv}) d\mathbf{x}_l d\mathbf{x}_s$$

Hidden scene Reconstructed image Hidden scene Reconstructed image

Hidden scene Reconstructed image Hidden scene Reconstructed image

Hidden scene | Reconstructed image | Hidden scene | Reconstructed image

[Guillén et al. 2020] (ICASSP)

SPAD

SPAD

All scene points contribute to all sensor pixels

All scene points contribute to all sensor pixels

All scene points contribute to all sensor pixels

Lenses map "bundles" of rays from points on the scene to the sensor.

SPAD

Resemble lens propagation operators

SPAD

SPAD

Propagate complex waves instead of scalar radiance

Propagate complex waves instead of scalar radiance

SPAD

- Defined by classic optics models
- Leverage LOS imaging methods

$$H(\mathbf{x}_l, \mathbf{x}_s, t)$$

$$H(\mathbf{x}_l, \mathbf{x}_s, t)$$

$$H(\mathbf{x}_l, \mathbf{x}_s, t)$$

$$H(\mathbf{x}_l, \mathbf{x}_s, t)$$

$$H(\mathbf{x}_l, \mathbf{x}_s, t)$$

VIRTUAL WAVE PROPAGATION

VIRTUAL WAVE PROPAGATION

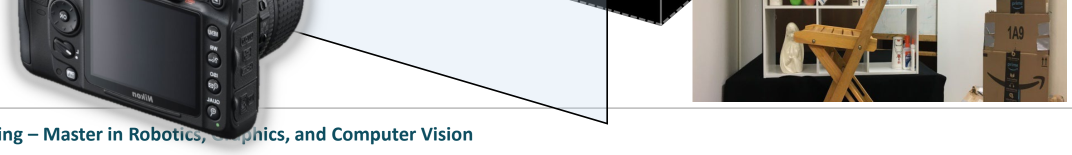
VIRTUAL WAVE PROPAGATION

VIRTUAL WAVE PROPAGATION MODELS

VIRTUAL WAVE PROPAGATION

VIRTUAL WAVE PROPAGATION


free delivery
music



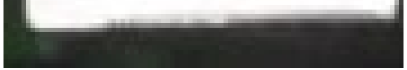
$$\int\limits_S \int\limits_L$$

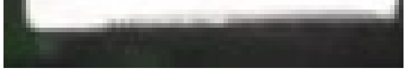
$$\int_S \qquad \int_L$$

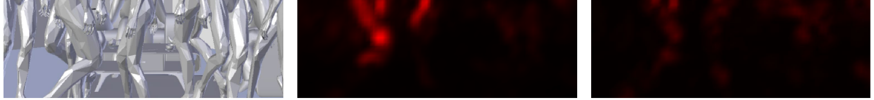
$$\int_{S} \int_{L}$$

VIRTUAL LOS

$$\int_S \int_L$$





but…

visible light (real optics) ⇒ Wavelength of 320-700nm

but…

visible light (real optics) ⇒ Wavelength of 320-700nm

but…

visible light (real optics) ⇒ Wavelength of 320-700nm

but…

visible light (real optics) ⇒ Wavelength of 320-700nm

lenses

$$\Delta x = 1.22c\frac{\quad}{A}$$

Aperture = Relay wall

lenses

$$\lambda = \frac{1}{\Omega}$$

$$\Delta x = 1.22c\frac{\quad}{A}$$

Aperture = Relay wall

lenses

$$\Delta x = 1.22c\frac{\quad}{A}$$

Aperture = Relay wall

lenses

$$\Delta x = 1.22c\frac{\quad}{A}$$

Aperture = Relay wall

lenses

$\Delta x = 1.22c$

A *Aperture = Relay wall*

REAL DEVICES

REAL DEVICES

REAL DEVICES

REAL DEVICES

REAL DEVICES

SPAD

SPAD

of the hidden scene!

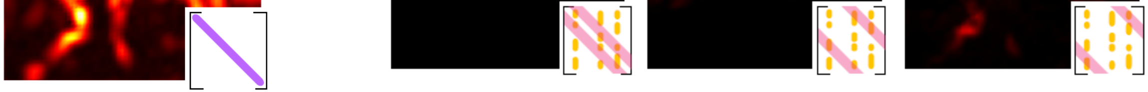
(N^2x1) (N^2xM) $(Mx1)$

Known Unknown Maybe (un)known

NxN image

for direct-indirect separation.

(e.g. relighting, direct-indirect separation)



[Young et al. 2020] Non-line-of-sight surface reconstruction using the directional light-cone transform

[Iseringhausen et al. 2020] Non-Line-of-Sight Reconstruction using Efficient Transient Rendering