

Differentiable Ray Tracing Simulator

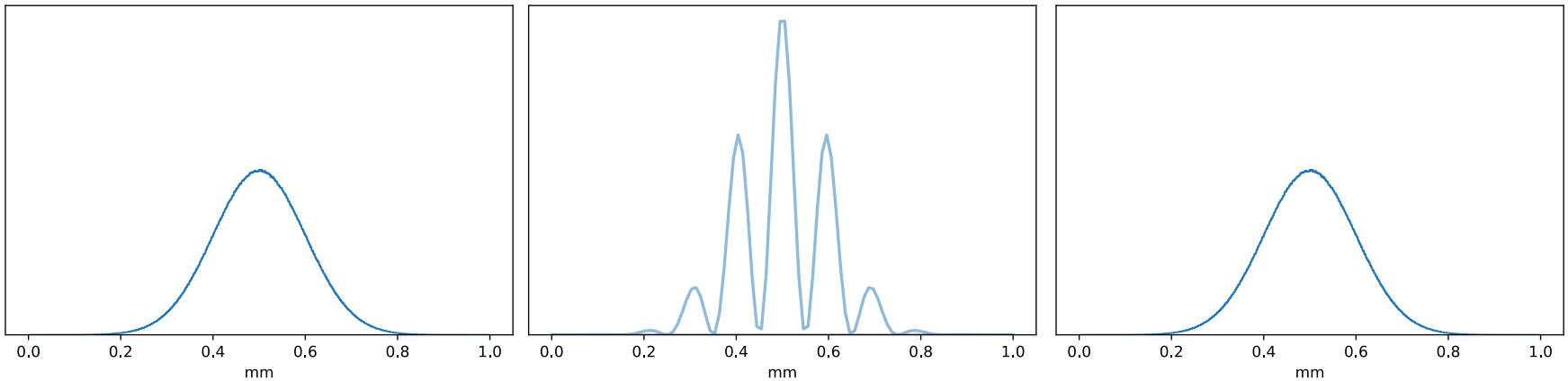
Maxime Vandegar, Michael Kagan

January 2021

- Imaging a 3d interference pattern.

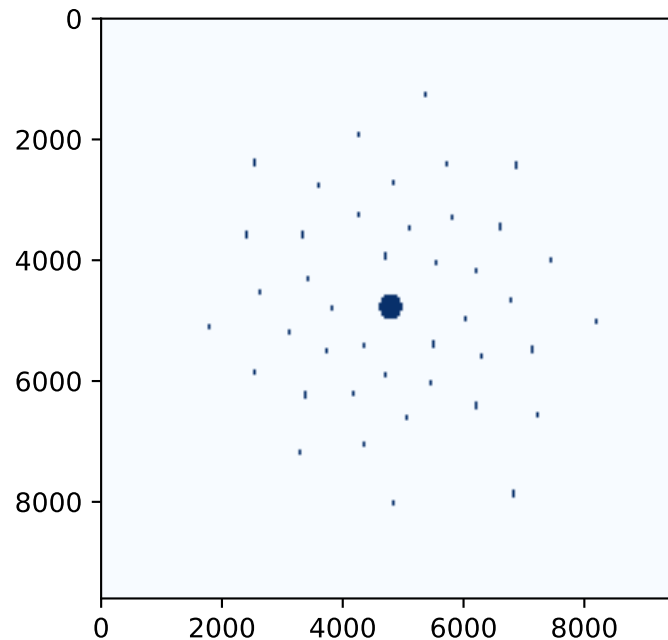
$$N \times f_{\gamma} \times \left[1 + \text{Cos} \left(\frac{2\pi}{\lambda} x + \phi \right) \right] \times \frac{1}{\sigma} e^{-\frac{1}{2} \left[\frac{x-\mu}{\sigma} \right]^2}$$

- $N = 10e6$ & $f = 2$.

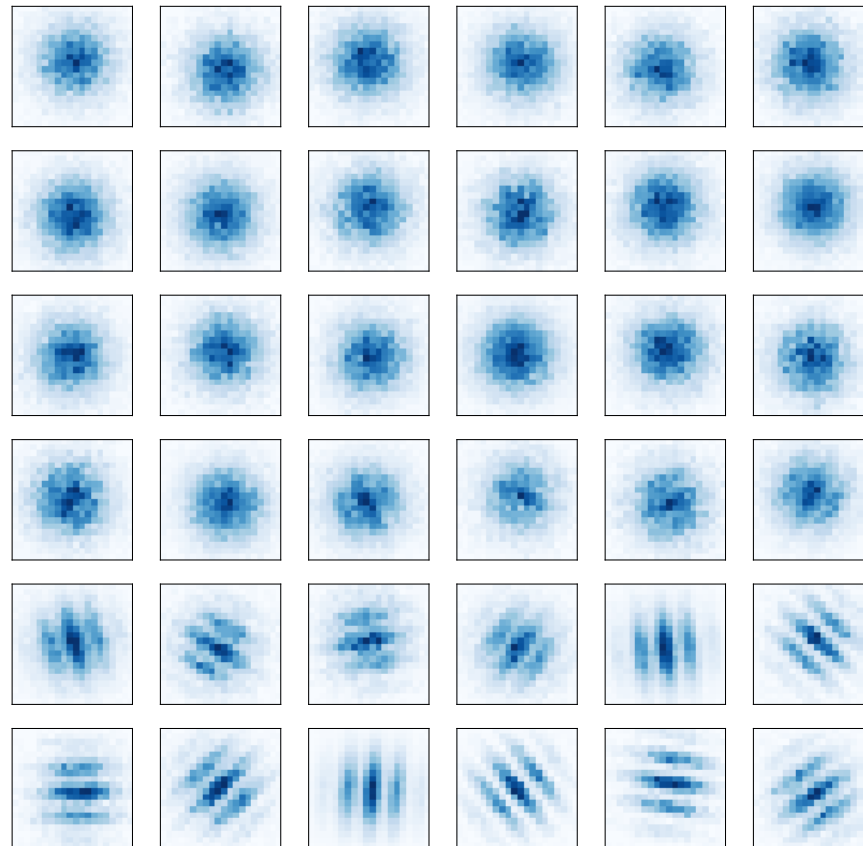


Sensor

- Each collected photon is represented by a dot (45 mirrors).
- The photons collected in the center of the sensor are directly coming from the cloud.

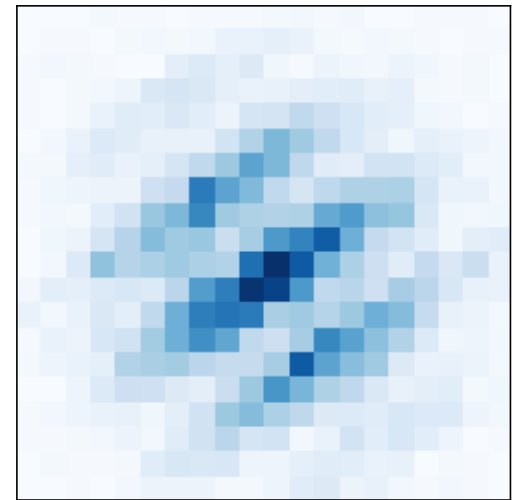
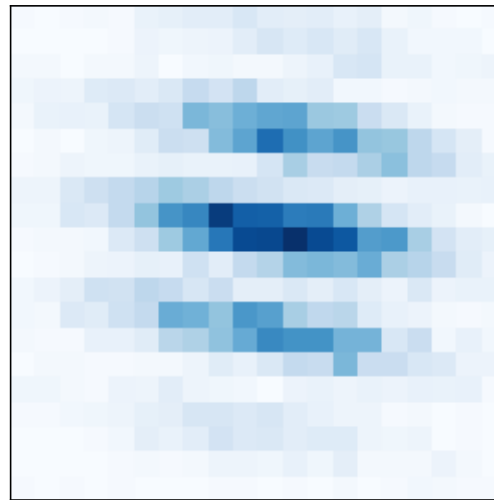
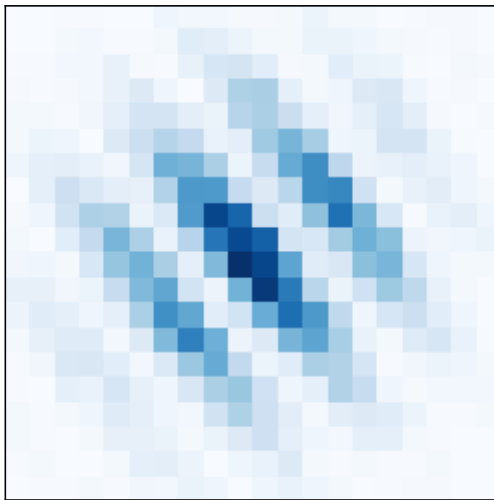


Multi-view image (1)

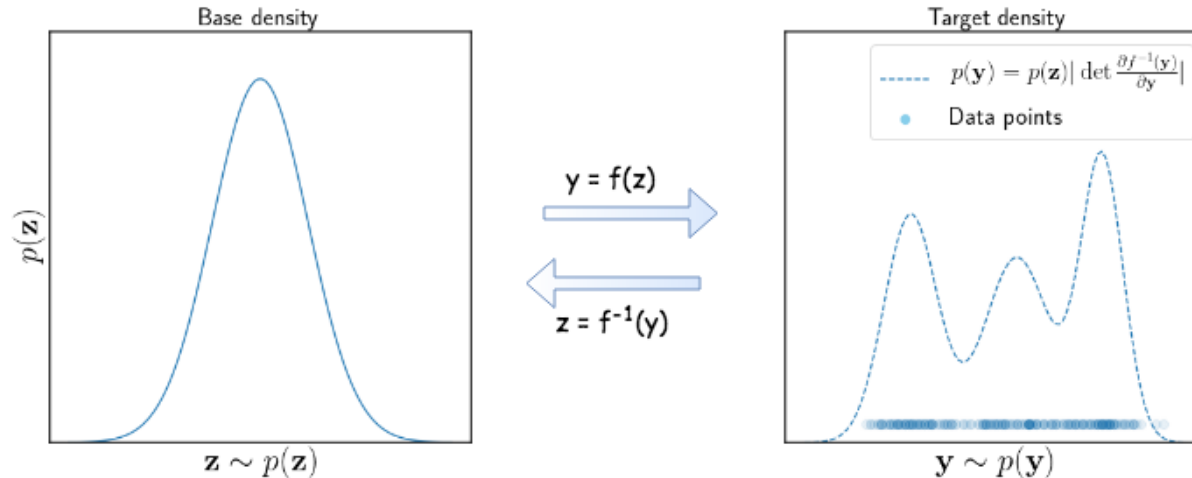


Cropped patches (20 x 20 pixels).

Multi-view image (2)



- 3D reconstruction.
 - Optimize $\|A(X) - B\|^2$ with gradient descent.
 - A is the simulator.
 - B is the ground truth image.
 - X is a density implied by a neural network (normalizing flow).



- MLE on the wave equation parameters.