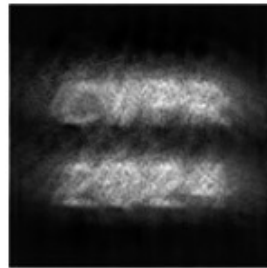# WaveMo: Learning Wavefront Modulations to See Through Scattering
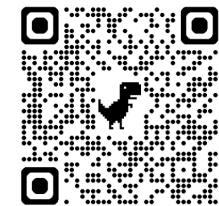
Mingyang Xie*, Haiyun Guo*, Brandon Y. Feng, Lingbo Jin,

Ashok Veeraraghavan, Christopher A. Metzler
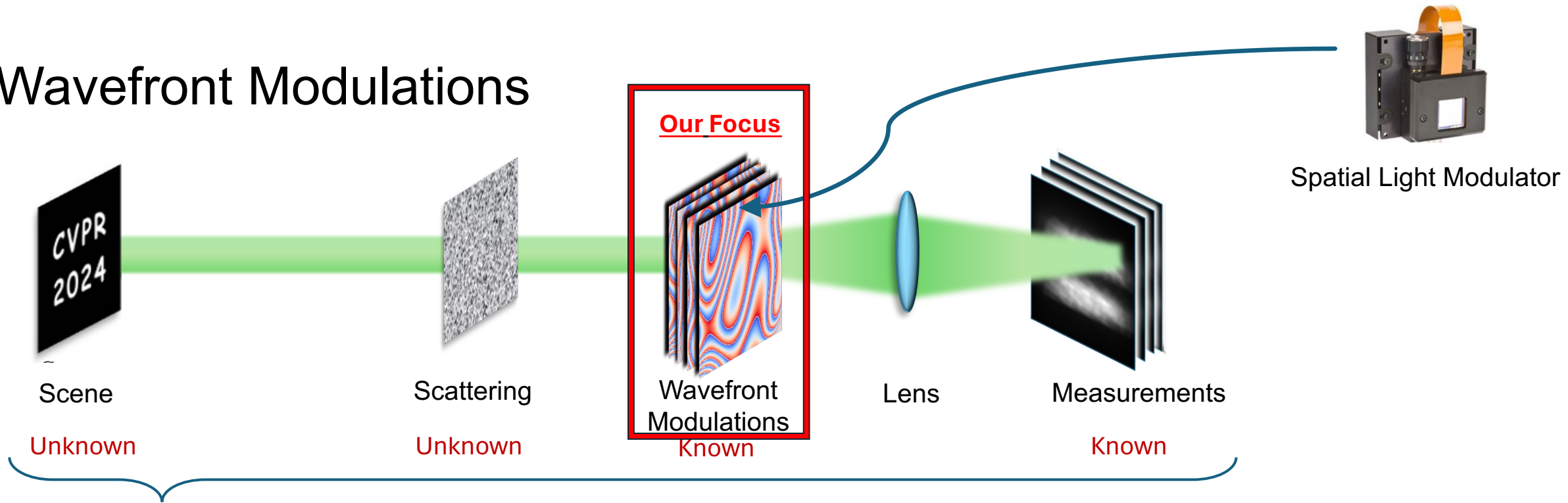
Previous
State-of-the-art

Ours

wavemo-2024.github.io

See Through Scattering

See Through Fog

See Under Skin

Wavefront Modulations

Scene — Unknown

Scattering — Unknown

Our Focus

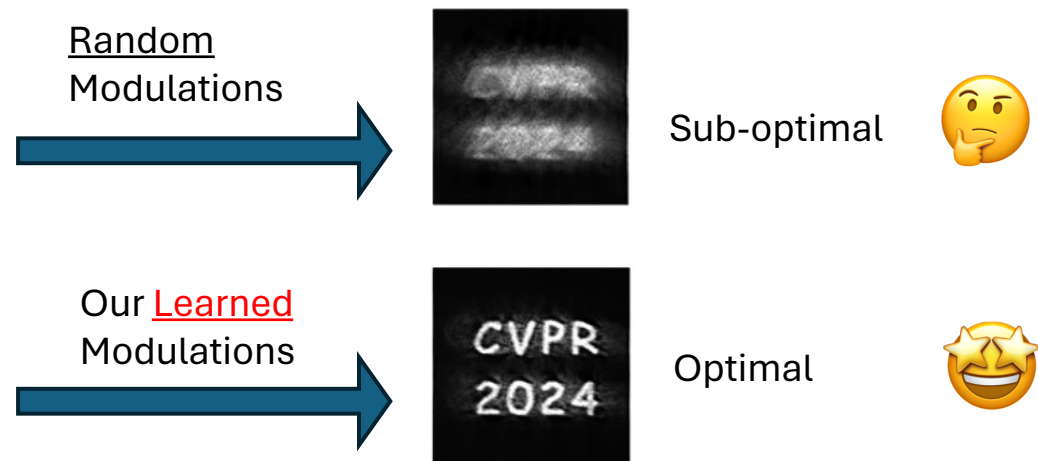Wavefront Modulations — Known

Lens

Measurements — Known

Spatial Light Modulator

Maximum Likelihood Estimation Problem —— more modulations, less under-determined.
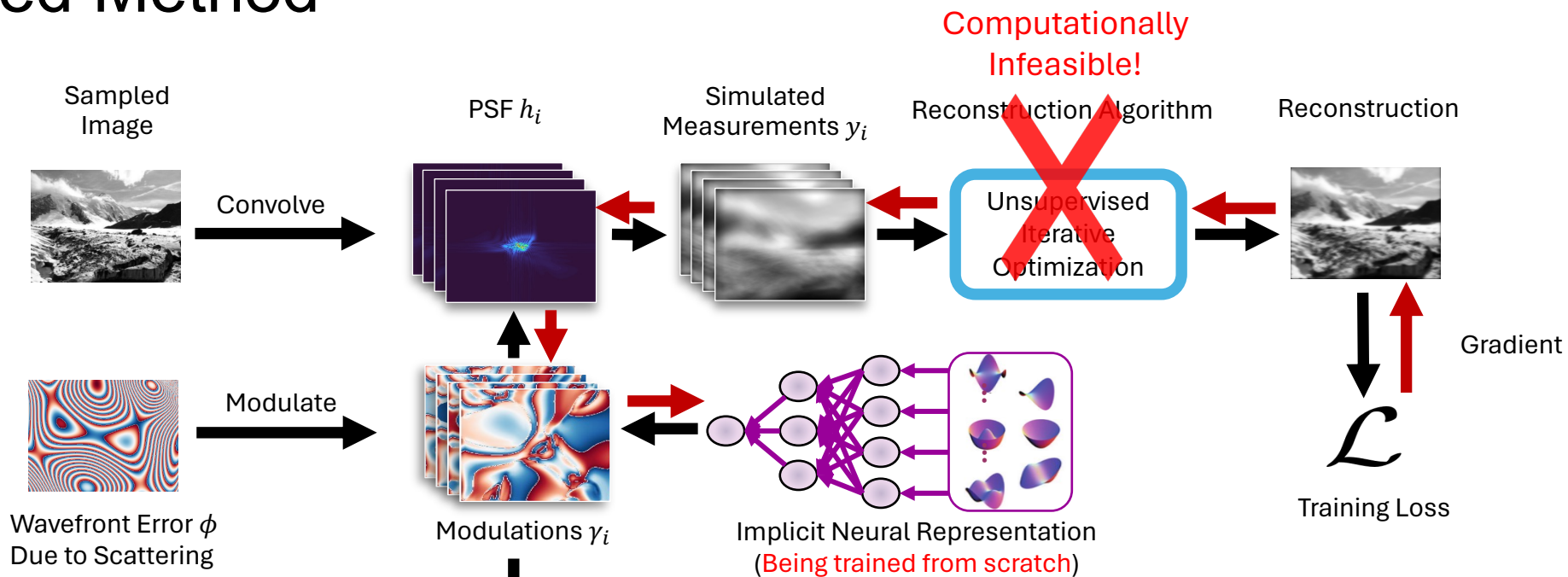
Unsupervised Iterative Optimization
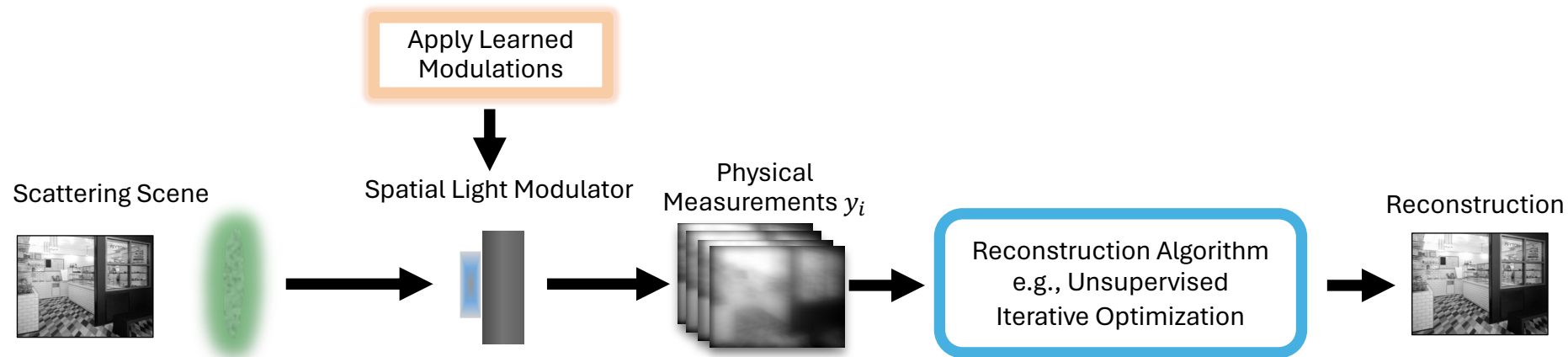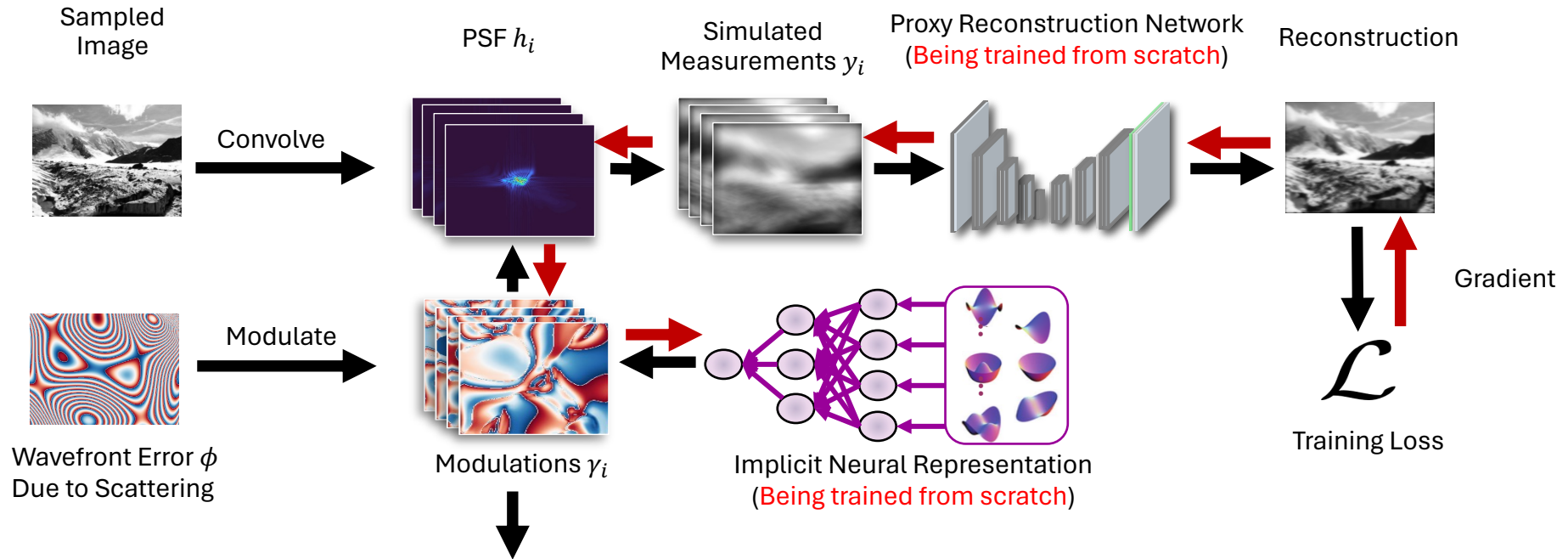e.g., Feng et al, *Science Advances*, 2023.

<u>Random</u> Modulations → Sub-optimal 🤔

Our <u>Learned</u> Modulations → Optimal 🤩

Proposed Method

Proposed Method

Training

Sampled Image

Convolve

PSF h_i

Simulated Measurements y_i

Proxy Reconstruction Network
(Being trained from scratch)

Reconstruction

Wavefront Error ϕ Due to Scattering

Modulate

Modulations γ_i

Implicit Neural Representation
(Being trained from scratch)

Gradient

$\mathcal{L}$

Training Loss

Apply Learned Modulations

Testing

Scattering Scene

Spatial Light Modulator

Physical Measurements y_i

Reconstruction Algorithm
e.g., Unsupervised
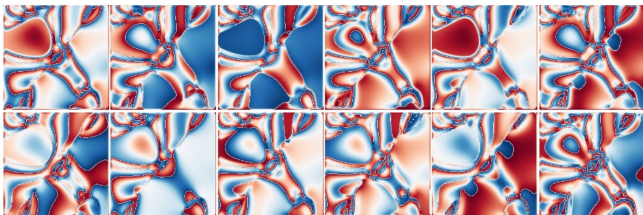Iterative Optimization

Reconstruction

Learned vs. Random

Modulations

Our Learned Modulations
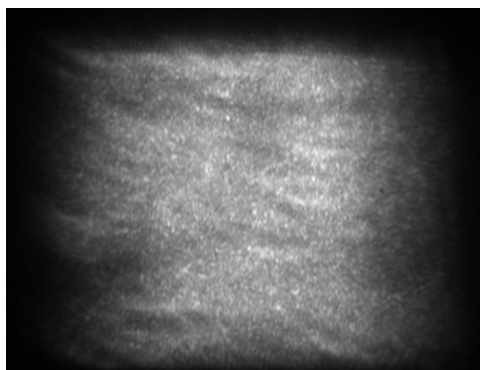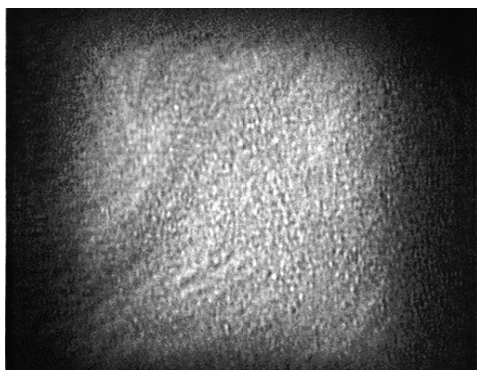
Modulation Transfer Function --- Higher the Better
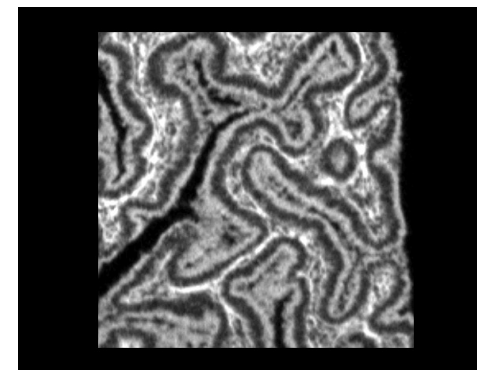
Learned
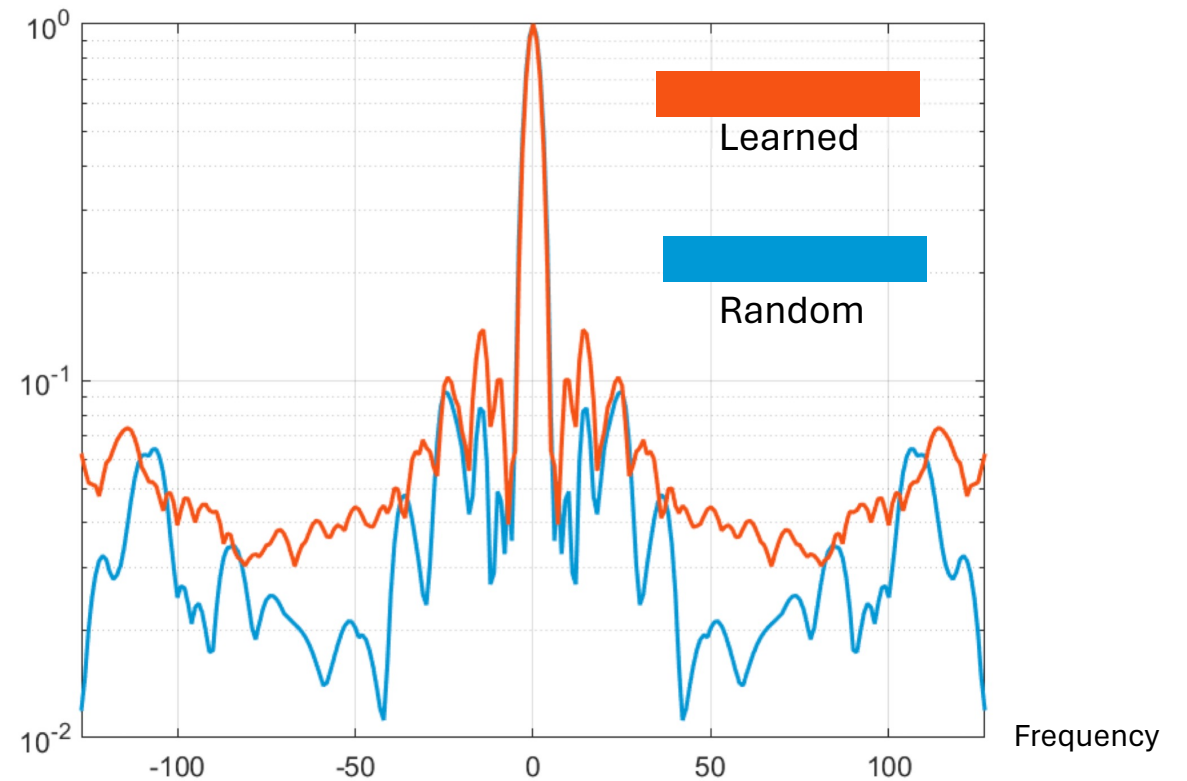
Random

Frequency

Our learned modulations can preserve more high-frequency information.
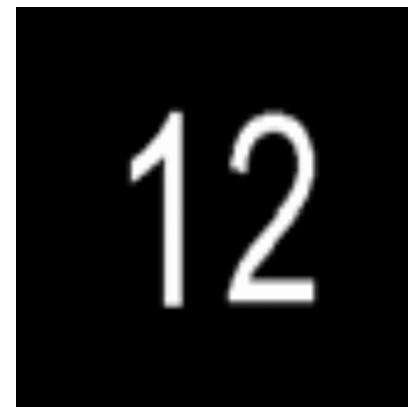
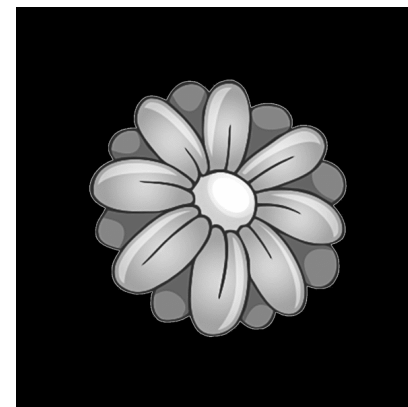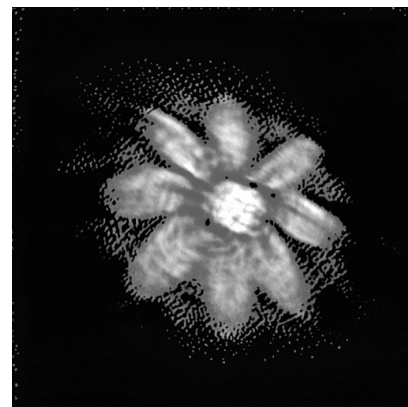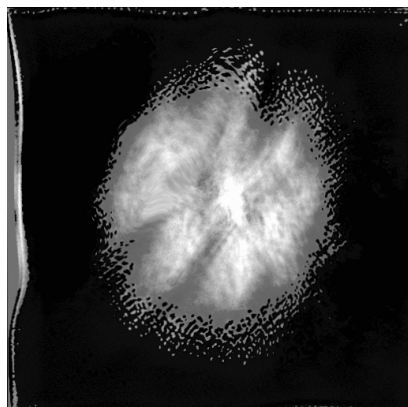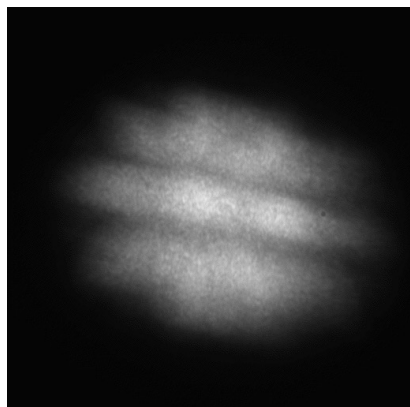Measurements   Random Modulations   Our Learned Modulations   Ground Truth
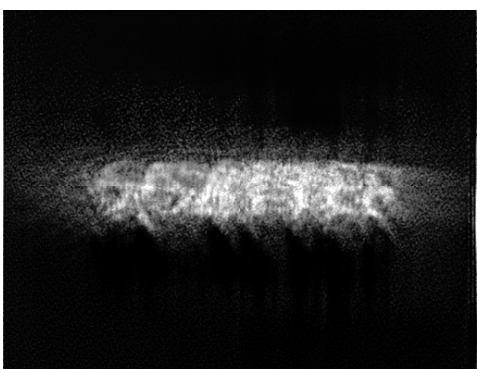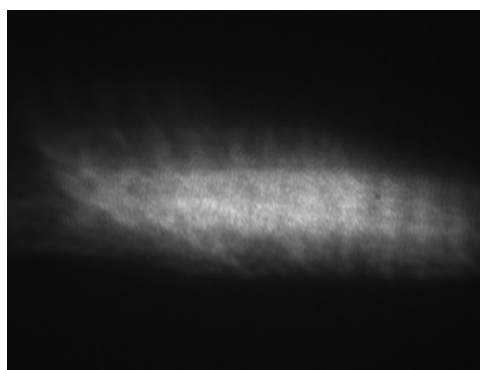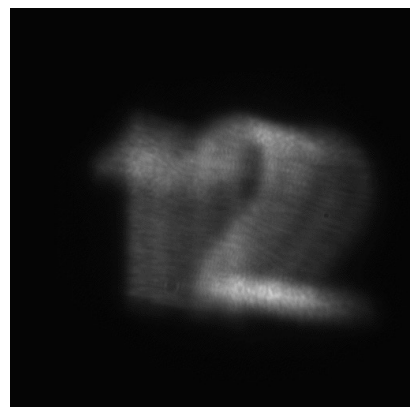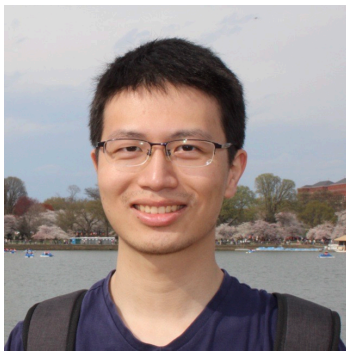
Measurements   Random Modulations   Our Learned Modulations   Ground Truth

Our Team

Mingyang Xie
谢铭阳

Haiyun Guo
郭海韵

Brandon Y. Feng

Lingbo Jin

Ashok
Veeraraghavan

Christopher
Metzler

UNIVERSITY OF MARYLAND

RICE

Massachusetts Institute of Technology

For More Information …

Project Page

https://wavemo-2024.github.io/

June 21, Friday. 17:15–18:45.

CVPR
JUNE 17-21
2024

Poster #104