Institut für Industrielle Informationstechnik
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Masterarbeit

Neural Ghost Imaging: Implicit Representations

Description

Develop reconstruction methods that use correlation matrices from Two Mode Squeezed Vacuum measurements as explicit priors. You will combine implicit neural representations or coordinate based networks with covariance aware modules and physics informed loss terms to reconstruct images from ghost imaging data. The project aims to quantify reconstruction quality as a function of squeezing and photon number, derive empirical scaling laws, and contribute novel model components that leverage the physics of correlations.

Tasks:

1. Implement a ghost imaging simulator in Strawberry Fields that outputs correlation matrices and ground truth images for varying squeezing and photon counts.
2. Implement classical correlation based reconstruction baselines and modern ML baselines (CNNs, INR).
3. Design covariance aware layers and physics informed loss functions that enforce consistency with measured correlations.
4. Perform systematic sweeps over squeezing parameter and photon budgets; evaluate with MSE, SSIM, PSNR and information theoretic proxies.

The work can be done in German or English.

Prior knowledge

- Python and simulation tools (Strawberry Fields)
- Signal Processing and Statistics
- Neural Networks (CNNs, MLPs)
- Inverse Imaging Problems

Research area

- Ghost Imaging & Compressed Sensing
- Implicit Neural Representations (INR)
- Physics-Informed Reconstruction
- Quantum Optics (Two-Mode Squeezed Va
- Covariance-based learning

Studiengang

- [x] Elektro- und Informationstechnik
- [x] Informatik
- [x] Mathematik
- [x] Physik

Alignment

- [x] Research
- [x] Implementation
- [x] Analysis and evaluation
- [x] Method development
- [x] Simulation

Start

At any time

Links

Mitarbeiterseite

Ansprechpartner

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