Masterarbeit

Adapting Foundation Models (SAM) for Quantum Microscopy

Description

Investigate how large foundation models such as the Segment Anything Model can be adapted to phase squeezed microscopy data using lightweight adapters and embedding alignment. You will generate realistic phase contrast and phase squeezed datasets, create a small labeled seed set, and evaluate zero and few shot segmentation performance. The project bridges state of the art transfer learning with domain knowledge from quantum imaging and produces practical guidance for applying foundation models to novel scientific imaging domains.

Tasks:

1. Simulate phase contrast and phase squeezed microscopy images under varying decoherence and noise conditions.

2. Implement adapter strategies (LoRA, lightweight adapters) and embedding alignment modules to map quantum phase images into foundation model feature spaces.

3. Evaluate zero and few shot segmentation and classification scenarios, measuring IoU, boundary F1 and robustness to domain shift.

4. Compare adapter approaches to full fine tuning and classical ZSL methods; run ablations on adapter size and seed label quantity.

The work can be done in German or English.

Prior knowledge

– Advanced ML (Transfer Learning, Zero-Shot Learning)
– Experience with Large Foundation Models (e.g., SAM)
– Python and PyTorch
– Understanding of Embeddings and Adapters (LoRA)

Research area

– Foundation Models/Generative AI
– Parameter-Efficient Fine-Tuning (PEFT)
– Quantum Phase Microscopy
– Zero-Shot and Few-Shot Learning
– Domain Adaptation (Natural to Physics ima

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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