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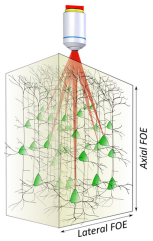
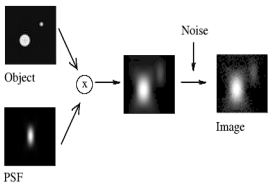
Master / Bachelor Thesis / HiWi

Unsupervised deconvolution invariant Computer generated holography

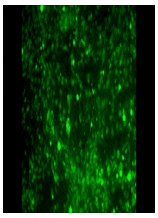
We are looking for a motivated and ambitious student with an interest in working at the intersection of computational imaging, deep learning and systems neuroscience.



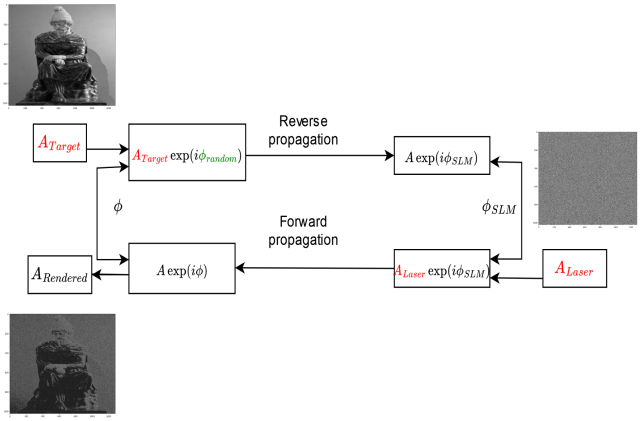
Holographic optogenetics[1]



Simple Convolution[2]


Calcium Imaging[3]

GS Algorithm[4]



Project overview:

The integration of model-based Deep Neural Networks (DNN aided inference)[5] offers a promising avenue for addressing complex inverse problems. By leveraging the strengths of both iterative algorithms and neural networks, these models are uniquely positioned to tackle challenges such as deconvolution and computer-generated holography (~phase retrieval). Our project aims to develop an unsupervised deconvolution invariant phase retrieval method by integrating model-based Deep Neural Networks (DNN aided inference). The goal is to achieve rapid deconvolution and phase retrieval within millisecond timescales while preserving high image fidelity. The applications of this research extend across domains, including systems neuroscience and augmented/virtual reality (AR/VR) technologies.

Tasks:

- The extent of the tasks will be adjusted based on the selected job duration (Master/Bachelor/Hiwi)
- Literature review on unsupervised and iterative deconvolution algorithms.
- Extension of the existing data generation pipeline to train deep learning based deconvolution algorithms.
- Validation experiments to compare the implemented deconvolution algorithm with state-of-the-art methods
- Integrating the deconvolution pipeline with the existing phase retrieval pipeline.

Requirements:

- Strong programming skills in Python.
- Basic skills in Bash Unix shells.
- Version control. (Git, GitHub, GitLab)
- Experience with libraries like Pytorch, Pytorch Lightning, Hydra, Numpy is a plus.

Our resources and offer:

- State of the art IT infrastructure well equipped to handle computationally expensive tasks.
- Guidance throughout the project with regular meetings and discussions.
- A potential publication in a top-tier conference/ journal.

How to apply:

Feel free to contact me with your queries. Please submit your CV and transcript, along with a brief statement of interest via the following email: ankit.amrutkar@lfb.rwth-aachen.de

References:
[1]https://doi.org/10.3389/fncel.2018.00469
[2]https://svi.nl/wikiimg/Convolution_1.png
[3]https://doi.org/10.1016/j.cell.2019.03.011
[4]Image Credits: Ankit Amrutkar,Lehrstuhl für Bildverarbeitung
[5] http://arxiv.org/abs/2012.08405