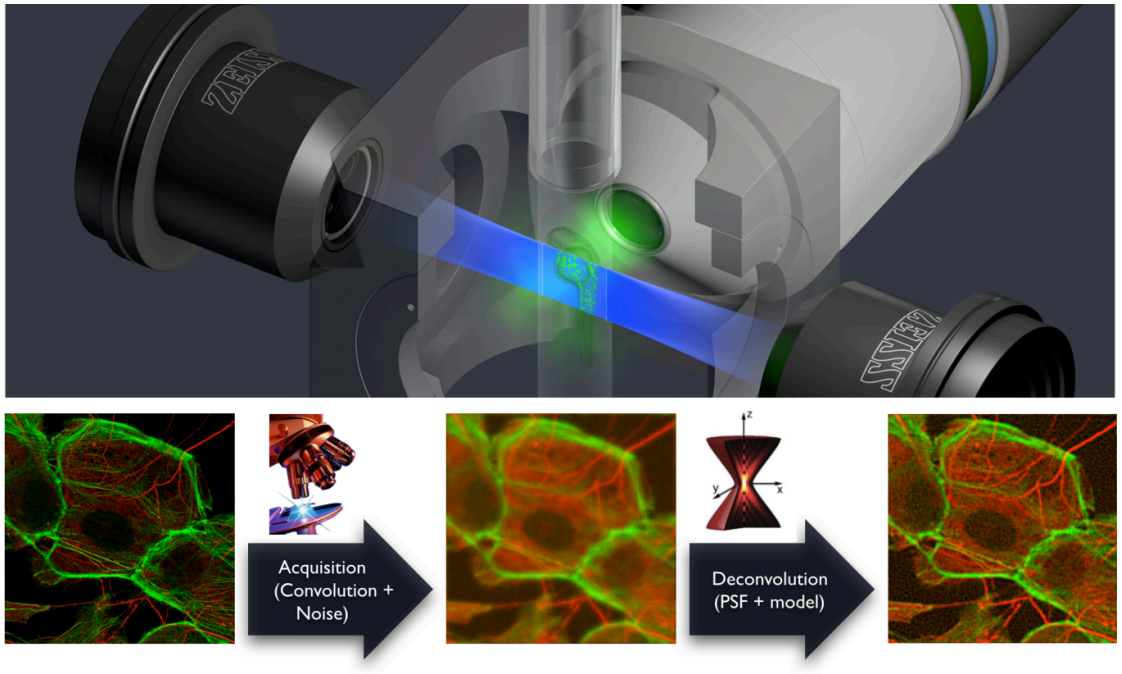
EPFL Hub for Image Reconstruction:

Student Projects 2023-24

3D Microscopy Deconvolution of Very Large Image with a Adaptive Resolution Scheme



Type: Master Semester Project or Master Thesis (Master)
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Project Context:

Modern fluorescent microscopes are capable of acquiring high-resolution 3D images of an entire specimen (e.g. light sheet microscopy). This generates very large, voluminous images that are difficult to process on a computer and unravel using deconvolution algorithms (https://www.wikipedia.com/en/Deconvolution). In this project we propose to develop deconvolution algorithms with a multi-resolution approach to address current limitations in processing large-scale 3D data.

Technical Insight:

To perform the deconvolution, we propose to split the point-spread function into several sub-blocks of different energies and different resolutions. The high-energy blocks will be used at full resolution, while the other blocks will be used at low resolution. This

approximation will only slightly affect the deconvolution result. In addition, the design of the deconvolution algorithms will be distributed and parallelized to gain in efficiency, scalability, and speed while handling large data volumes generated in advanced microscopy techniques.

Project Deliverables:

- Scalable deconvolution algorithms
- Application in real-world, large-scale microscopy data.
- (Master thesis) Documentation & Tutorials: Comprehensive guides to facilitate future use and development.
- (Master thesis) A potential publication detailing the algorithm and its applications in scientific imaging.

Work Structure:

- **Algorithm Design and Development:** 60%
- **Implementation in Microscopy Image Deconvolution:** 25%
- **Optimization and Refinement:** 10%
- **Documentation and Tutorial Creation:** 5%

Prerequisites:

- Proficiency in Python.
- Basics in signal processing.
- Ability to design, analyze and optimize complex algorithms.

Collaborative Exploration:

The student will collaborate with a multidisciplinary team of experts at the EPFL Center for Imaging, and have access to state-of-the-art resources and datasets. This project is a unique opportunity to contribute to pioneering research, bridging the gap between computational efficiency and the increasing demands of advanced microscopy imaging.