

# MASTER THESIS - Development of a modular 3D-printed Cellphone Microscope Platform which benefits from Machine Learned Image Processing

The goal of the presented thesis is to implement super resolution microscopy techniques, such as dSTORM/PALM, into an existing modular 3D printed microscopic environment. The latter is consisting of 3D printed chassis parts in combination with off-the-shelf optical components. A cellphone shall be used for image detection and processing. The super-resolution extension, which is to be developed during the thesis, shall fit well into the Lego-like modular arrangement of the chassis. Common super resolution reconstruction algorithms have to be implemented in the existing Android-based image processing software of the microscopy environment. Additionally the developed system shall be tested in cooperation with the University Clinic of Jena in both fixed and living cells under "field" conditions, meaning long-term measurements inside an incubator.

The motivation for the project is to provide a budget-priced microscope for educational purposes on the one hand. On the other hand the system shall later be used as disposable microscope for the work in biohazardous environments or as medical device for improving the human life standard in regions, lacking in infrastructure, such as development countries.

## Methods

- Develop robust optical design for many different electro-optical devices (e.g. Smartphone Cameras)
- Integrate electronic to let the optical components communicate with each other
- Enhance image quality of the acquired raw-data by inverse problem solving (i.e. deconvolution, 3D reconstruction, etc.) using Machine Learning aspects (i.e. Tensorflow, OpenCV, ANDROID)
- Develop a user-friendly toolbox to motivate researchers and scientists especially for educational and financial lower situated regions

## Tasks:

- Develop and test several hardware architectures for a modular microscope design
- Modell an image-processing library which mimics the hardware-setup to use it for inverse modeling (i.e. deconvolution or 3D reconstruction)
- Apply Machine Learning Algorithms to raw data to enhance its information content
- Test the devices in real-world environments like schools or biological laboratories

## Qualification and Skills:

- You should be a Master student with experience in Optics and/or Electronics and/or Informatics and interested in Microscopy/Machine Learning
- Experience in programming MATLAB or PYTHON, JAVA/Android, PYTHON highly desirable
- Knowledge about Optics, its theoretical descriptions and experience in the optical lab
- Experience in CAD Design/Construction e.g. using Autocad INVENTOR

If you are highly motivated and willing to learn new things & acquire new skills or have any questions, please don't hesitate to contact:

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