Lehrstuhl für Bildverarbeitung

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Master's Thesis: Algorithm Development for a Microscopy-based Deep Phenotyping Platform for Plant Pathogens

Description

Confronted with a steadily growing world population and the challenges posed by changing environmental conditions, securing the food supply is one of the most important current and future challenges. The breeding of stress-resistant crops is a key element in overcoming this problem. In this process, suitable genotypes are selected based on certain traits. This "phenotyping" can be carried out at different levels (whole fields (population), individual plants, individual organs down to individual cells). Prof. Ulrich Schaffrath's working group at the Department of Molecular Plant Physiology is investigating the interaction between plants and pathogenic fungi. The aim is to produce cereal plants that are resistant to pathogenic fungi. In this process, wheat and/or barley leaves are temporarily genetically modified by bombarding them with DNA-coated gold particles. Fungal spores are then applied to the treated leaves and examined microscopically to determine whether the modified cells are more susceptible or more resistant to this fungus (Figure 1). This microscopic process is time-consuming and labor-intensive and thus requires acceleration by automation.

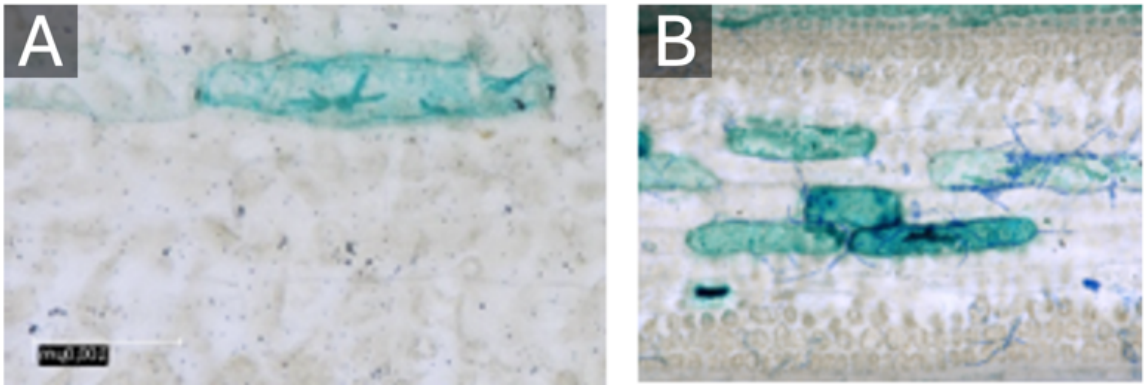

Figure 1: Automated transmitted light microscopy images of transiently genetically modified plant cells

A, B: GUS-stained cells infected by the barley powdery mildew fungus that were automatically selected by the existing platform at the Department of Molecular Plant Physiology. These are either single cells infected by the fungus (A) or several cells infected simultaneously (B).

Tasks

As part of the master's thesis, an existing automated microscopy system, which has already been developed in cooperation between the two institutes, is to be optimized so that the genetically modified cells can be recorded and assessed automatically. The aim is to develop new deep learning-based methods for detection, segmentation and classification that can automatically process and analyze cells in recorded image data at different resolution levels. The functionality of the developed algorithms is to be confirmed both qualitatively and quantitatively in validation experiments.

Requirements

- Interest in digital image processing
- Programming skills (ideally in Python)
- Previous experience with deep learning is advantageous
- Interest in biological questions

Our Offer

The offer is aimed at Master's students with a technical background (e.g. electrical engineering or computer science) and is supervised in cooperation between the two institutes mentioned above. A working place can be provided at the Insitute of Imaging and Computer Vision and includes access to modern IT infrastructure including a powerful GPU computing cluster. There is also the opportunity to gain direct insight into the microscopy hardware and to record image data for training and validation of algorithms in direct collaboration with students from the Department of Biology.

Interested? Please contact us with your CV and current transcript of records via email to johannes.stegmaier@lfb.rwth-aachen.de.