Zealquest Asia

Zealquest Group Company

LemnaTec
MEMBER OF THE NYNOMIC GROUP

PHENOAIXPERT HTC

The Versatile Phenotyping System for Laboratories

LemnaTec AIxpert Product Family

Documentation, Phenotyping, Seed Testing and more

PHENOAIXPERT HTC

The Semi-Automated Compact Multi-Sensor Phenotyping System

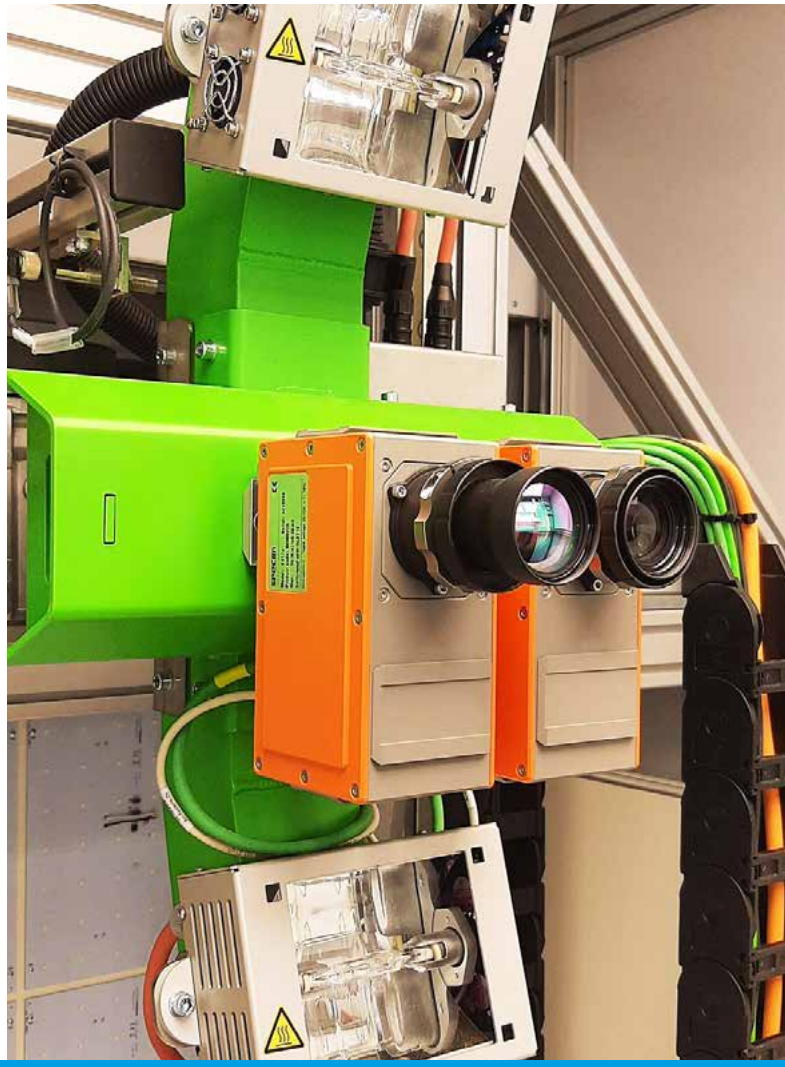
The PhenoAIxpert HTC is a significant step towards automation of phenotyping plants of a height up to 700 mm and with a diameter up to 500 mm. It can harbor pots up to 195 mm in diameter, and a maximum weight of 10 kg (plant, soil, water, and pot). It is suitable for many plant species including most common crops and vegetables. The system performs morphological and physiological phenotyping with a range of sensors. Applications are numerous in research, breeding, and product development. The PhenoAIxpert HTC combines high flexibility in imaging with a compact footprint. With this the PhenoAIxpert HTC is a compact semi-automated phenotyping system, where users are loading up to 12 plants onto a conveyor for subsequent measuring. Plants are transported by the conveyor through a series of imaging stations, where specialized cameras acquire high resolution images.

Image and Data Acquisition

The PhenoAIxpert HTC delivers data wherever multi-dimensional phenotyping at increased throughput is required. Applications comprise but are not limited to:

- Candidate screening in plant breeding
- Assessment of responses to environmental factors
- Testing active agents in plant protection
- Plant stress and plant pathology assessments
- Measuring responses to biostimulants and fertilizers
- Plant developmental studies in research

In the PhenoAIxpert HTC, each plant is imaged sequentially with one or multiple camera units, employing different wavelengths in the visible and non-visible spectrum. In addition to visible light imaging, HTC offers imaging options in the infrared and near-infrared spectrum, hyperspectral, fluorescence, and chlorophyll fluorescence imaging, as well as 3D laser scanning. The result is an unprecedented number of reproducible data points on many aspects of plant health and development.



Key Features of the PhenoAIxpert HTC

- All major phenotyping cameras and sensors are available
  - RGB (top view 28.8 Megapixel and side view 12.4 Megapixel imaging, including turning the plant in front of the lens)
  - Chlorophyll fluorescence 1.4 Megapixel imaging with 50 cm x 40 cm field of view top view imaging, 10,000 µmol m-2 s-1 saturation pulse, F0, FM, F', FM', F0' and FM" imaging
  - Hyperspectral imaging VNIR 400-1000 nm, SWIR 900-1700 nm; top and side view, including turning the plant in front of the lens
  - 3D Laser Scan: X-Field of view up to 842 mm. Z Range up to 800 mm and resolution 500 µm. Z-Resolution 25.1 µm, top and side view, including turning the plant in front of the scanner
  - Simultaneous scan of both hyperspectral cameras and laser scanner possible
- Image processing capabilities for each sensor type
- Plants on conveyor passing by imaging stations; system takes measurements of pre-loaded plants
- Automatic measuring of up to 12 plants in one run
- Maximum flexibility of plant height due to lifting mechanism for optimal distance to the camera
- Plants or seedlings in pots or trays
- Sample height up to 700 mm, sample width up to 500 mm; max. allowed weight per pot with plant and moistened soil: 10 kg
- PhenoAIxpert HTC cabinet: 6050 mm x 2400 mm footprint; 2850 mm height, 3500 kg weight (approximate values)

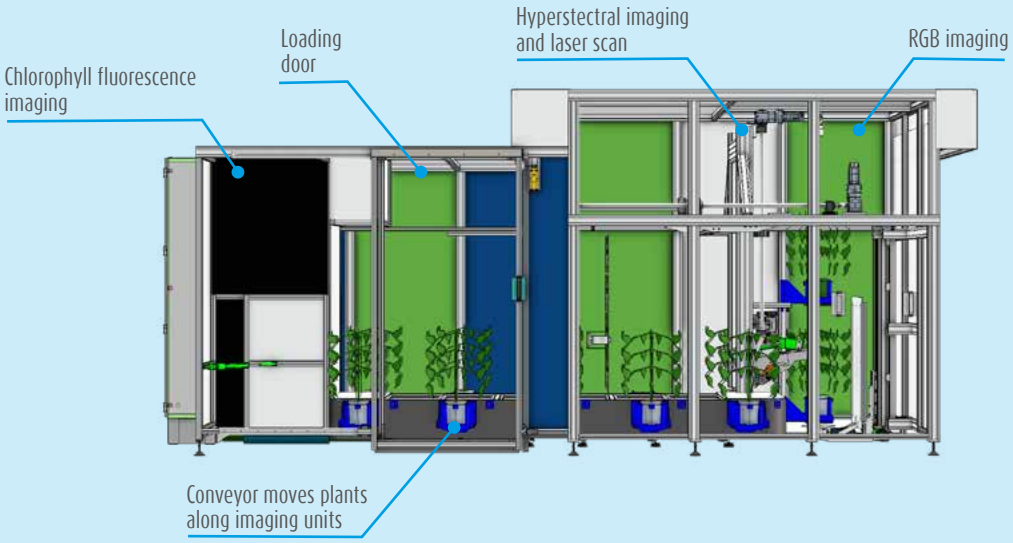
The PhenoAIxpert HTC is a compact phenotyping system with one cabinet that combines multiple imaging stations connected with a conveyor, which brings the plants from one imaging station to the next.

Small Footprint
Highly Flexible Phenotyping System

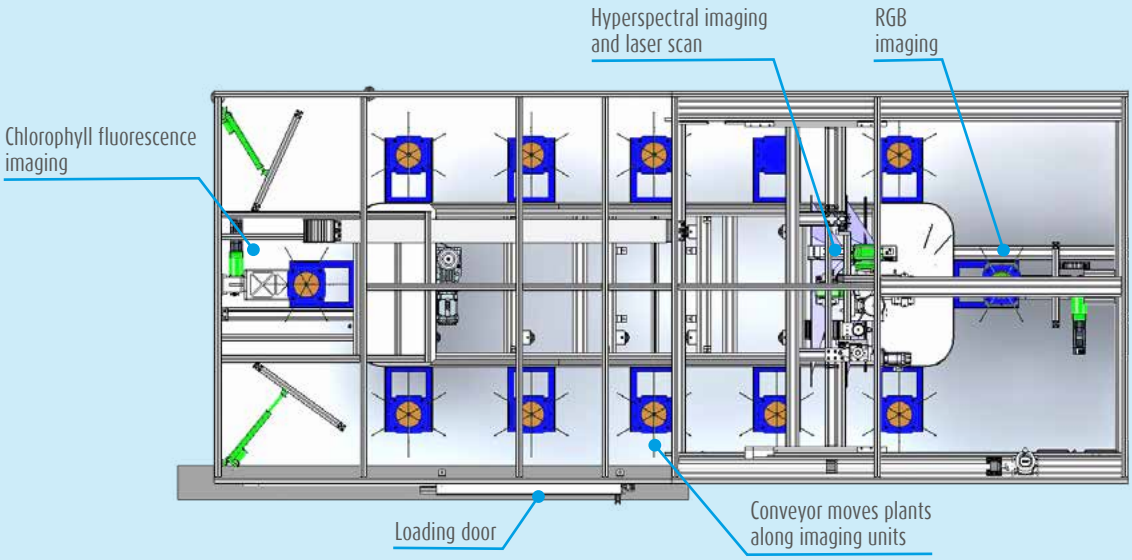
All imaging sensors, corresponding lights, and scanning devices together with the conveying system are mounted inside a single cabinet having 6050 mm x 2400 mm footprint and 2850 mm height. The PhenoAIxpert HTC combines the imaging flexibility of automated phenotyping systems with compact construction and is an affordable alternative to fully automated, space-demanding systems. With the unique lifting mechanism, plants can be precisely imaged from very early stages until the maximum height of 700 mm. The lifting mechanism ensures that young seedlings or plants that generally stay small are perfectly focused. Having a semi-automated operation mode, the users pre-loads up to twelve plants into the system and starts the image recording process. If a dark adaption phase before chlorophyll fluorescence imaging is demanded, this adaptation time can be added to the measuring cycle. After finishing all measurements inside the system, users exchange the plants for the next round of imaging, so that high throughput and regular measurements are possible.

PhenoAIxpert HTC operating mode

- Operator loads plants into the system, each plant is positioned onto a conveyor position
- Operator defines image recording schedule at the user interface
- System starts and carries out all images according to operator's schedule
- System provides data output
- Operator unloads the plants after measurement



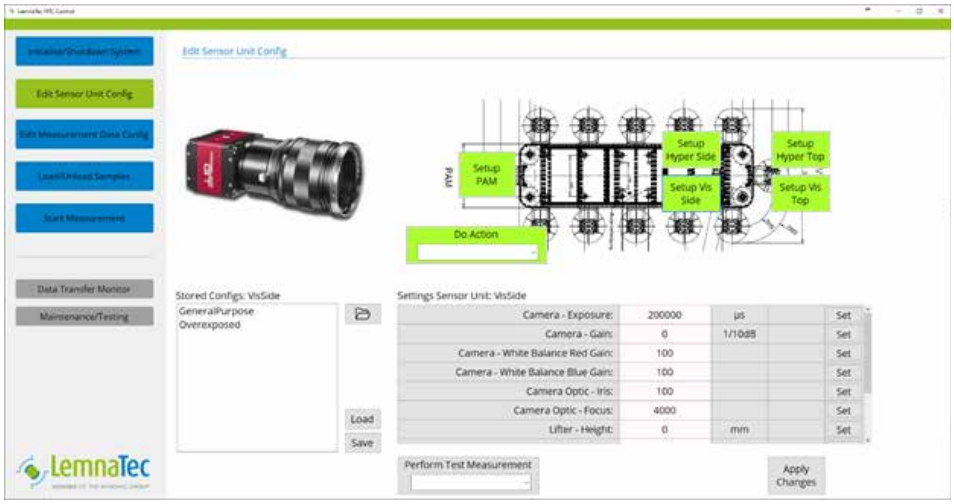
Side view of the PhenoAIxpert HTC with different imaging stations along a central conveyor system



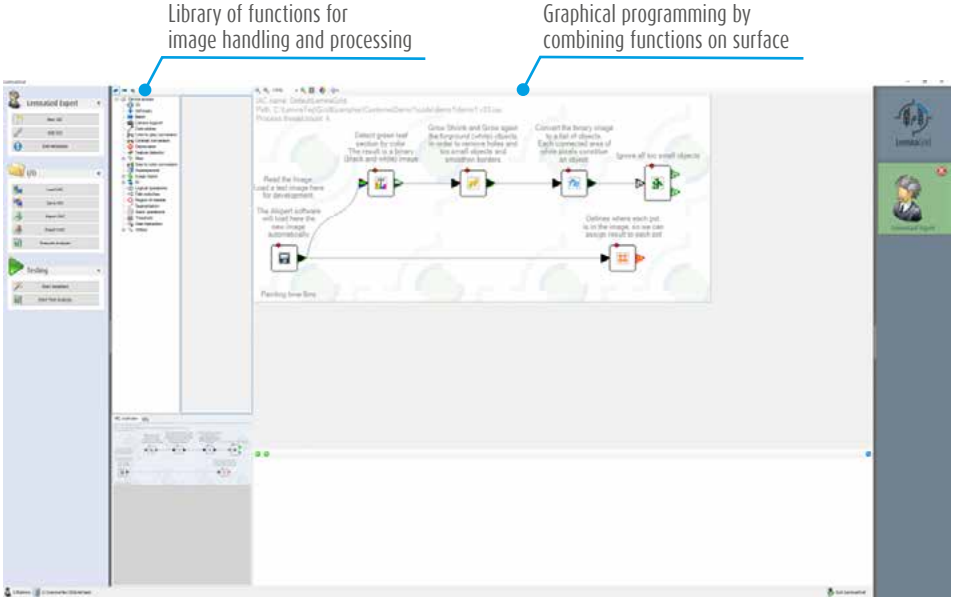
Top-down view of the PhenoAIxpert HTC with different imaging stations along a central conveyor system

Software

The PhenoAIxpert HTC is delivered with a comprehensive software package. The software enables all possibilities of system control so that users can provide sample information and program a complete workflow for the samples. Users can define the samples loaded into the system, and give information such as species, genotype, treatment, or other grouping parameters. For all available cameras, users can determine which imaging principles are used with the loaded samples – full set or selected sub-set – and make the essential settings such as exposure, white balance, and more.



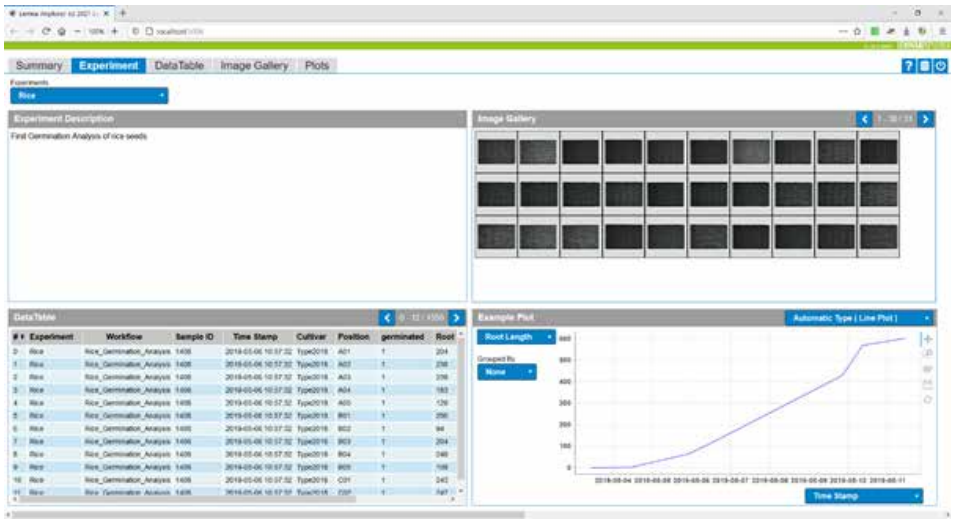
After imaging all data are stored and accessible for image and data processing. With LemnaGrid, we provide a user-programmable image processing toolbox that allows for analyzing the recorded image data. LemnaGrid comprises a large library of functions to handle, analyze, and process various types of image data. By combining functions on a graphical surface, users can establish analytical pipelines.

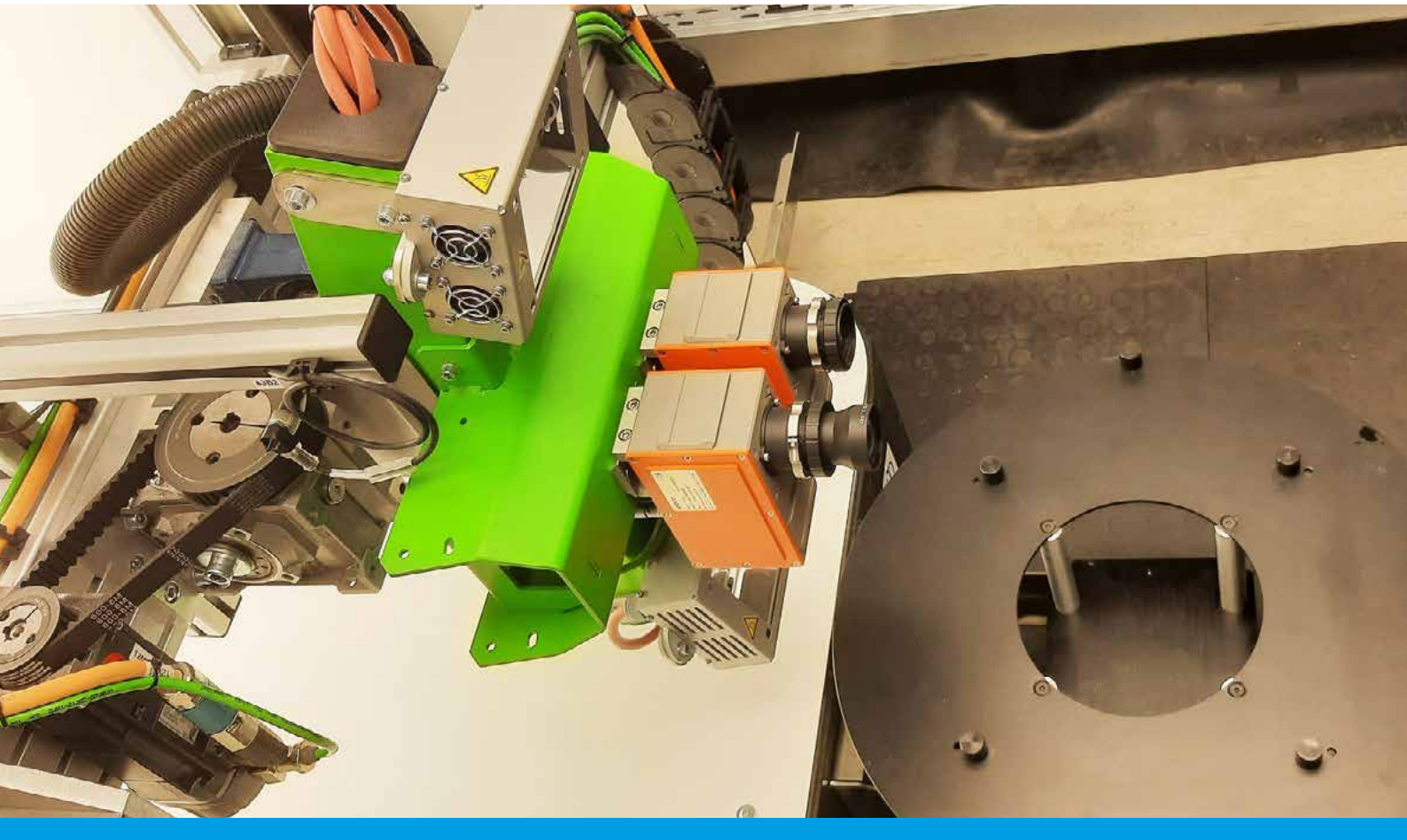


In addition, we offer the development of customized analyses for user-generated images, including machine learning procedures.

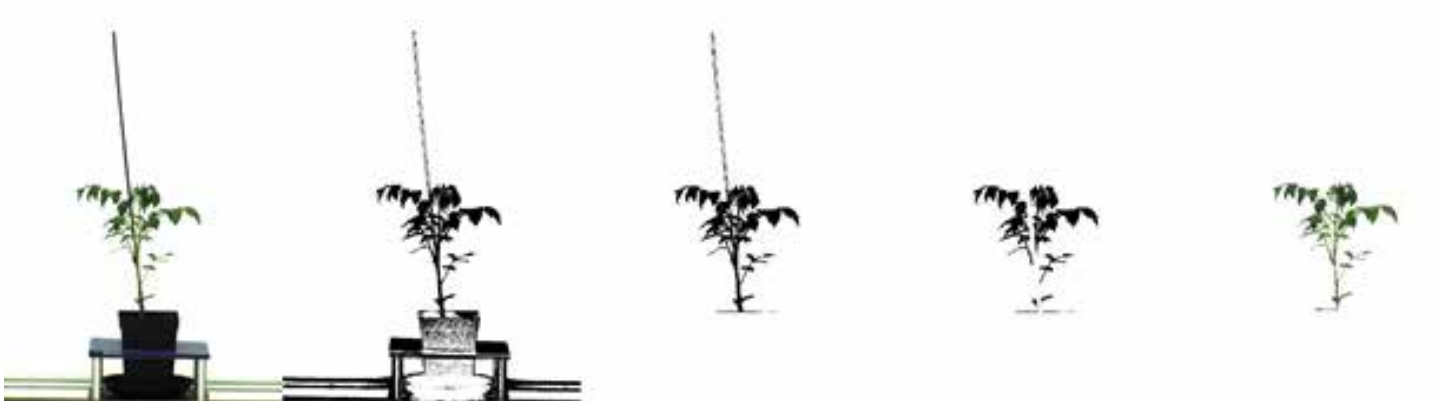
The LemnaAIxplorer enables access to and visualization of all images, analyses, and related data. Tabulating and plotting functions are available together with image browsing.

All data can be exported as CSV files or directly delivered to standard data bases.

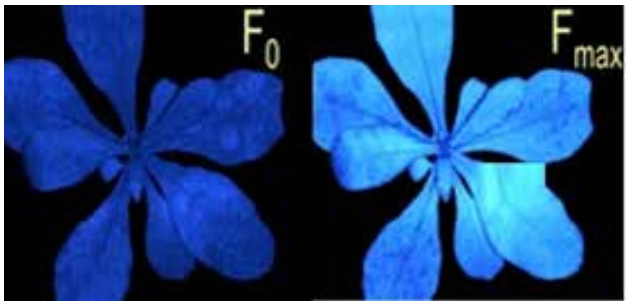




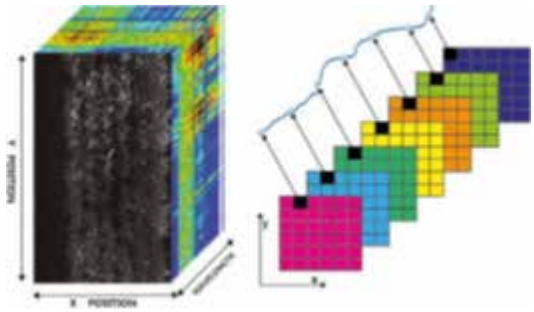
Exemplary image processing



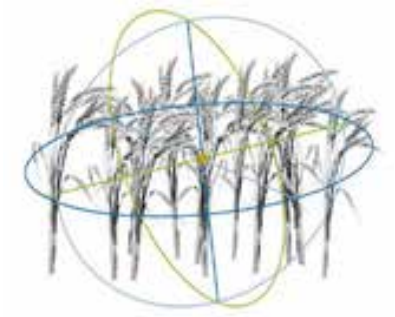
RGB imaging delivers data on plant size, color, and morphology and can be used in studies on growth and development, on responses to environmental factors, or in genotype comparisons.



Chlorophyll fluorescence imaging delivers data on photosynthesis-related parameters, such as Fv/Fm. Parameters serve to determine physiological status and stress responses.



Hyperspectral imaging delivers data on physiological and biochemical properties of the plants and enables vegetation index determination. Applications comprise development, stress responses, disease resistance, and more. Note that physiological data interpretation requires validation experiments and calibrations with the particular sample material.



3D laser scans deliver data on structural properties of the plants and can serve in studies on growth of development, e.g., as a result of genetic properties or in response to environmental factors.

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