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Multi-sensor platforms for crop phenotyping- Innovative technology tools at the beginning of the food chain

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Abstract

To achieve food and energy security of an increasing world population likely to exceed 9 billion until 2050 represents a tremendous challenge for the agricultural and horticultural sector. To satisfy future demands, crop production has to be increased by 70% of which 90% has to be achieved by a raise of crop yield on areas still in use. Consequently, innovative remote sensing technologies and corresponding data collection, analysis and sensor fusion methods, enabling an objective and non-destructive monitoring of adolescence parameters, pest infestation and yield parameters, are of increasing importance. These new technologies for example assist decision making in precision agriculture to optimize herbicide and fertilizer applications, deliver the basis for mechanical weed control in organic farming or support selection in plant breeding to achieve shorter breeding periods of improved cultivars. In this context, we have developed two different multi-sensor platforms for non-invasive phenotyping in plant breeding using different kinds of innovative optical sensors like light curtain imaging, hyperspectral imaging and 3D-Time-of-Flight cameras. The first platform, developed in the interdisciplinary research project "BoniRob", is an autonomous field robot. The first application of the system is the detection and redetection of single maize plants during repeated measurements and the determination of single plant properties. The second platform, developed in the interdisciplinary research project "BreedVision", was designed for *in-situ* dry biomass determination of small grain cereals cultivated in plot based plant breeding field trials. Both platforms were tested under field conditions. The calibration results corroborate the advantages of sensor fusion to determine complex agronomic traits like for example dry biomass yield. The developments represent a cornerstone to accelerate the knowledge gain of genotype-phenotype interactions in plant breeding, an important component at the beginning of the food chain to achieve food security for future generations.

Biography

Lucas Busemeyer has completed his Master of Sciences in "Mechatronic Systems Engineering" at University of Applied Sciences Osnabruck, Germany, in 2011. He is scientific officer at the Faculty of Engineering and Computer Science at University of Applied Sciences Osnabruck and Ph.D. student at University of Hohenheim, Germany. His main field of research is the development and assessment of multi-sensor fusion methods for precision plant phenotyping.