Connecting different field sensors for plant analysis on a meta level

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Abstract

Using multiple sensors for phenotyping on field scale needs sophisticated, fast and efficient analysis to overcome the limits of the phenotyping bottleneck. Typical multi sensor platforms generate more than 1 TB of data per day. To enable a reasonable interchangeability between scientific groups the data has be to enriched with experiment-, user-, climate- and sensordata. This publication shows how field datasets can be connected to provide informative value from secondary sensors for measuring temperature, CO2 or radiation.

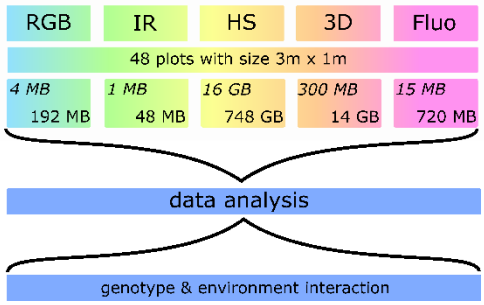

Figure 1: The phenotyping bottleneck as it is created by the huge datasets coming from different sensors on the field that has to be analysed by highly automated data processing pipelines

1. Background

Monitoring genotype-environment interactions of plants on field scale is an essential step to transfer knowledge gained in laboratory and greenhouse experiments to relevant conditions and to verify them. This requires a high sampling rate of various genotypic parameters along with environmental conditions, both spatially and temporally. Such a transition from controlled to actual conditions represents an important aspect of what is named the phenotyping bottleneck. Digital phenotyping using automated measuring setups is an essential step to face the restriction of this bottleneck (Figure 1). Today high throughput screening using various high resolution sensors is applicable under field conditions. Such a multi-sensor approach results in terabytes of data coming from all kinds of sensors measuring e.g. reflection for different wavelength, fluorescence, biomass and 3D surface as well as weather data. This is a further bottleneck, since large amounts of data need to be processed, reduced and combined to a complex information including biological relevant information.

2. Method

Building such a multi-sensor system requires calibrated sensors as well as highly automated, transparent testing routines, a high accuracy for positioning as well as a continuous monitoring of environment conditions. Fast database connection and data management is important as well as a reliable data enrichment using meta data for experiment, environment and sensor calibration (see Figure 2).

This poster will give a profound introduction of latest field phenotyping platforms. The connection of the different sensors to a complex multi-sensor platform measuring equally plant and environmental data. Latest installations produce datasets of more than one terabyte per day coming from different sensors to image different aspects of the plant like reflectance, content and geometry. We show data acquisition, data extraction, parameter calculation and data evaluation using an intuitive processing pipeline resulting in a detailed field map for nitrogen level or biomass.

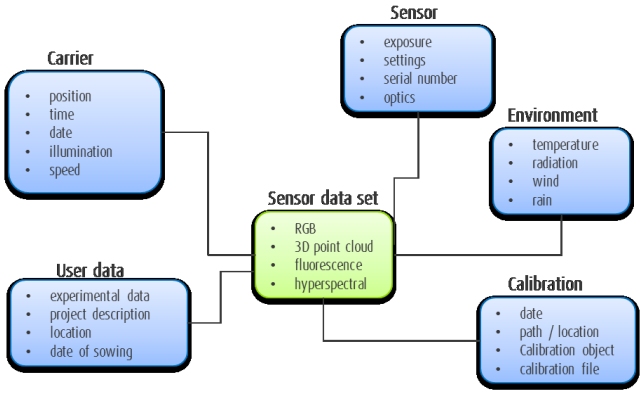

Figure 2: Different datasets coming from different sensors is combined together with user information to a meta dataset that explains the data completely. Each meta dataset can be depicted to be standalone.

3. Conclusion

Data coming from different sensors is enriched with data from the environment, the sensor carrier, the user and the experiment. Each dataset can be depicted to be standalone. The complete dataset of a field can be used for sensor fusion, mapping of single sensors, as well as for analysis regarding climate change.