Digital Twins Models for Crop Phenotyping, Management and Yield Forecasting

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Abstract

Phenotype characterization is an exciting new field that links agriculture and data science. Thanks to advances in remote sensing and artificial intelligence, we can now accurately quantify field-scale phenotypic information and integrate this big data into predictive and prescriptive management tools.

Our past work has shown that phenotypic information measured from UAS is more precise and reliable than manual field measurements. In addition, we have shown that the vast size of this data can outweigh the complexity of the problem, to the point where even a simpler algorithm can outperform a sophisticated algorithm when big enough training data are available. This is because the big data captures even very infrequent aspects of the problem of interest, which can be modeled with simple logics.

The availability of UAS data makes it possible to develop digital twin models to forecast future plant growth and develop in-season management plans. A digital twin model is a virtual representation of real-world entities and processes. These models use early growth patterns of a crop as input to artificial intelligence algorithms so that the algorithms can predict crop performance during the next 10, 20, or 30 days ahead of the last data point collected by the UAS. Crop growth features forecasting results can be useful for the management of irrigation, growth regulators, maturity of the crops, and to obtain early-season yield estimation.

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