Large-Scale Rendering of Simulated Crops for Computer Vision

Visualization as Data Source for Machine Learning
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Purpose

• Provide a workflow to put AI/ML methods into practical use in agriculture
• Crop analysis from field-scale monocular images
• Investigation into training success on these hard problems with infinite data

AI/ML

Observation

Question

Hypothesis

Experiment

Analyse Data

Conclusion
Challenges and Necessities

• Recent publications in plant segmentation have addressed:
  • Complex backgrounds
  • Complex outlines
  • Prior information on field setup or plant structure
  • Additional measurement devices

• For practical field-scale experiments, methods would need to overcome all of those challenges!

• Our pipeline is intended to test algorithms on large-scale data sets
Central Steps

- **Model technologies**
- **Learnability and conditioning**

- **More data, quality labels**
- **Larger models**

**Tayloring**

**Usability Assurance**
Pipeline Context

• Data2Model Pipeline
• Digital Twin idea – CPlantBox generation of plants
• Subsequent analysis
  • Of mechanisms
  • Of field-scale interactions
Training Pipeline

CPU

CPlantBox

DC CPU

Lighting
Texture
Shape
y-Mask

PlantVis

DC GPU

Unreal Instance
Tensorflow

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Real-World Samples

• Rhizotron test fields in Selhausen
• Wheat plants seeded in fall
• Measurement of growth phase through manual inspection
• Early stage growth
Synthetic Ground Truth

- Pretraining with qualified information
- Rendering of Plant Geometry
- Utilization of light/surface/geometry shaders for randomization
- Virtual crop field scenario
  - Complicated outline and background
  - Hard structural analysis tasks