

Research and Application of Multi-Scale Three Dimensional Plant Modeling

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Abstract : Reconstructing and analyzing three-dimensional (3D) models from situ measured data is important for a number of researches and applications in plant science, including plant phenotyping, functional-structural plant modeling (FSPM), plant germplasm resources protection, agricultural technology popularization. It has many scales like cell, tissue, organ, plant and canopy from micro to macroscopic. The techniques currently used for data capture, feature analysis, and 3D reconstruction are quite different of different scales. In this context, morphological data acquisition, 3D analysis and modeling of plants on different scales are introduced systematically. The commonly used data capture equipment for these multiscale is introduced. Then hot issues and difficulties of different scales are described respectively. Some examples are also given, such as Micron-scale phenotyping quantification and 3D microstructure reconstruction of vascular bundles within maize stalks based on micro-CT scanning, 3D reconstruction of leaf surfaces and feature extraction from point cloud acquired by using 3D handheld scanner, plant modeling by combining parameter driven 3D organ templates. Several application examples by using the 3D models and analysis results of plants are also introduced. A 3D maize canopy was constructed, and light distribution was simulated within the canopy, which was used for the designation of ideal plant type. A grape tree model was constructed from 3D digital and point cloud data, which was used for the production of science content of 11th international conference on grapevine breeding and genetics. By using the tissue models of plants, a Google glass was used to look around visually inside the plant to understand the internal structure of plants. With the development of information technology, 3D data acquisition, and data processing techniques will play a greater role in plant science.

Keywords : plant, three dimensional modeling, multi-scale, plant phenotyping, three dimensional data acquisition

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