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Wheat ear growth modeling based on a polygon

Key words: Visual inspection; Virtual crop; Three-dimensional modeling

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Motivation

As a research direction of virtual plants, virtual wheat can simulate the whole growth and development cycle of wheat in a few seconds by computer, which greatly shortens the research time.

Using crop modeling technology to construct the digital growth scenario of wheat provides potential research and economic value for monitoring wheat growth, analyzing wheat growth trend, and preventing wheat pests and diseases.

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Main idea

Polygons are used to model the lemma and palea instead of the wheat grains in the ear, and polygonization is carried out to simplify the model structure of wheat and improve the computational efficiency.

Combining simplified polygon modeling, collision detection of wheat grain in growth simulation is carried out to make it more realistic and efficient.

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Method

1. Overall processing flow

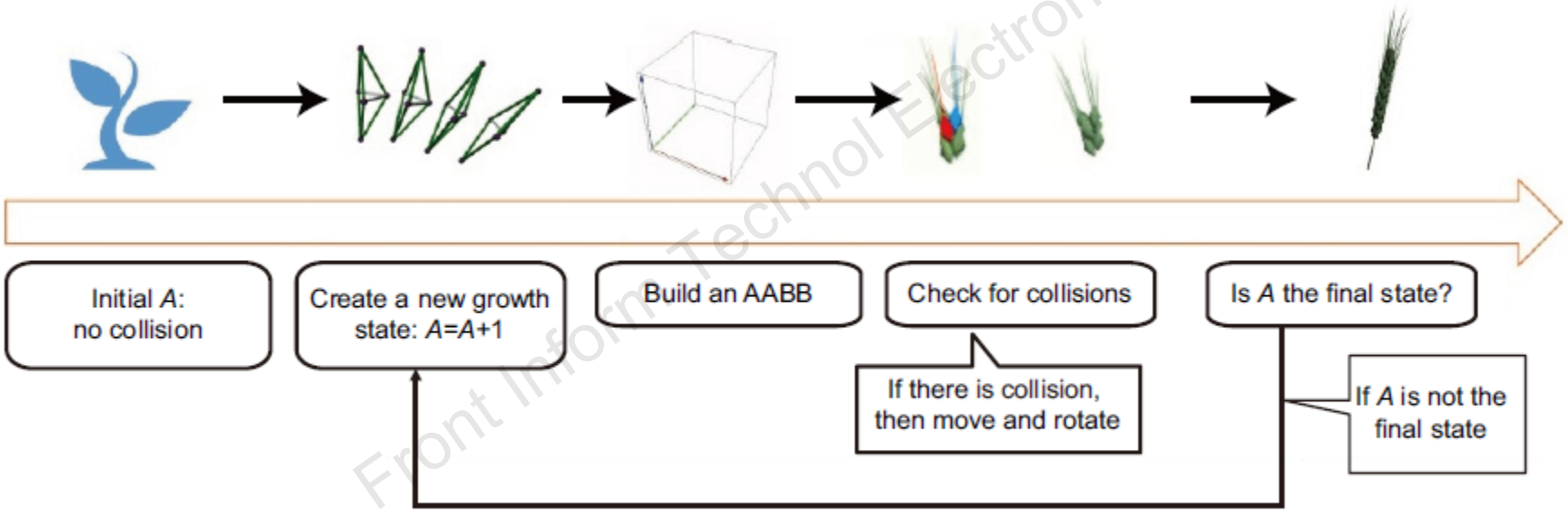

Fig. 1 Overall processing flow (AABB: axis-aligned bounding box)

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2. Assembly modeling steps of wheat ears

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Fig. 4 Assembly modeling steps of wheat ears

3. Grid interpolation control samples

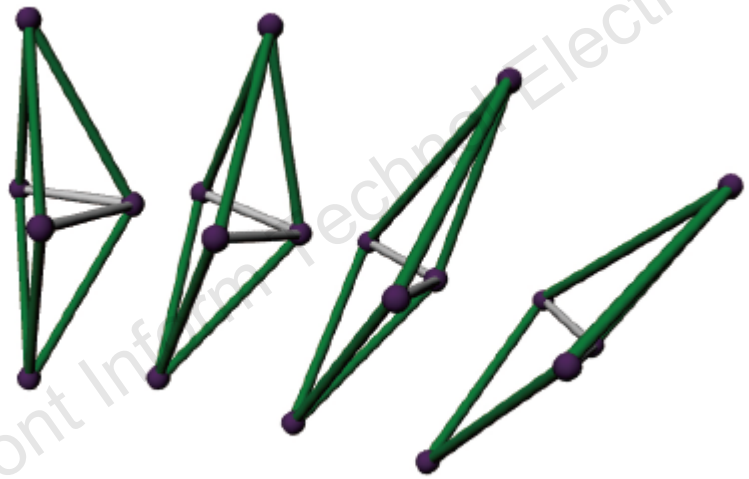

Fig. 7 Grid interpolation control samples

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Major results

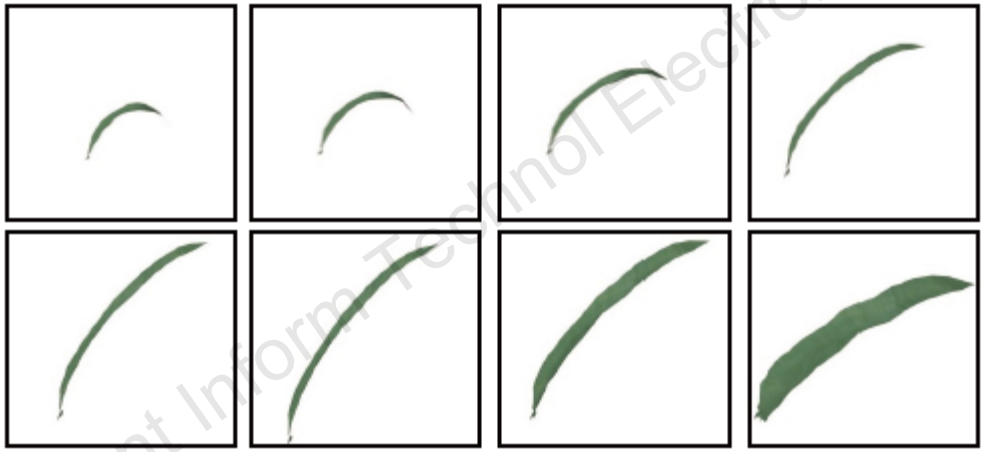

Fig. 9 Leaf growth process

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Major results

Fig. 10 Wheat ear growth process

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Major results

Fig. 11 Wheat growth process

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Conclusions

We have used morphological data to extract the morphologic and geometric information, and then characteristic parameters to establish an algorithm for modeling the main wheat ear structures.

A polygon-based geometric model has been used to construct 3D models of wheat ears in different growth stages. The models constructed are accurate and close to the measured model.

Compared with traditional methods such as the 3D point-cloud method and stereopsis method, the presented method is simple and cost-effective, and can simulate the dynamic process of wheat ear growth.

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