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Modeling the blade shape of landscape trees

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Blade is very important organ which is not only for the physiology process but for the appearance structure of the plants, especially landscape plants. So it is necessary to make a library of blades for the plant 3D visualization. The 3D digitizing instruments were used in some researches to build the blade model (Loch, *et al.,* 2005). This blade model was made up of a lot of facets and it is time-consuming to visualize the plants using this model, especially for visualization of the dynamic growth of trees. In this study, a 3D blade library was built for more than twenty kinds of landscape trees, which were measured with 3D digitizing method. The data of these blades were transformed into horizontal coordinates and the leaf shapes of these plants were modeled by simple function models.

Blades from 22 kinds of plants were selected in the nursery garden of Tengtou Company (29°42' N, 121°22' E) in Zhejiang province. All the blades were either fusiform shape blade or lanceolate blade. 5 blades for each kind of tree were sampled and measured with a 3D digitizer (FastSCAN Scorpion, Polhemus, USA). The 3D blade models were built. A mouse interaction program was developed to obtain the coordinate data of blade margins by reading the scanned file, and then the coordinates were transformed into 2D data. These data was normalized to obtain the blade shape. Furthermore, the data of blade margins were computed with a quadratic function $y = a\,\mathrm{x}^2 + b\,\mathrm{x} + \mathrm{c}$, which is often used to describe blade shape (Stewart and Dwyer, 1999), as well as the new composite function $y = \sin(\pi\, x^e)$. The parameters *a, b, c* and *e* of the two model were estimated with the Least Square methods and the similar and simple blade model was built.

All the sampled blades were measured and the blade models were built using the 3D digitizer (pictures not shown). The normalized blade shape was simulated using both quadratic function and the composite function. The parameters for 10 kinds of blades were given in Table1 (Others not shown here). For most of the blades, the results obtained with the composite function were better than the quadratic function. Moreover, only 1 parameter was used for the composite function. It was simple and useful for modeling the tree growth. By using these parameters, as well as the length and the largest width of blade, the simulated blade can be used to build the plant model.

The parameters for the blade shape were similar for some different kinds of plant. Thus, we can conclude that it is not enough to identify the tree only by using the parameters of leaf shape.

Table1. The parameters for the blade shape fitted by the two functions

Plant Names	*a*	*b*	*c*	*e*
Magnolia denudata	-4.048	3.987	0.017	0.994
Malus halliana	-3.748	3.482	0.216	0.723
Elaeocarpus decipiens	-4.105	4.143	-0.048	1.045
Michelia chapensis	-4.063	3.959	0.068	0.904
Cinnamomum camphora	-3.752	3.441	0.127	0.749
Myrica rubra	-3.523	3.916	-0.191	1.509
Prunus serrulata	-3.761	3.353	0.215	0.681
Koelreuteria paniculata	-3.846	3.478	0.178	0.729
Zelkova serrata	-3.526	3.048	0.252	0.626
Sapindus mukurossi	-3.814	3.574	0.148	0.765

Note: *a*,*b, c* were the parameters for the quadratic function model and *e* for the composite function

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