

3D Modeling of Trees from Freehand Sketches

Makoto Okabe*
Tokyo University, Japan

Takeo Igarashi†
Tokyo University, Japan

Abstract

We will present a user interface for quickly and easily modeling three-dimensional (3D) botanical trees from freehand sketches. The system generates 3D geometry from a two-dimensional (2D) sketch based on the assumption that trees spread their branches uniformly. Several editing operations are implemented, such as adding, cutting, and erasing branches. Our system also predicts, and generates, branches automatically. The user can continue editing a 3D tree by selecting the predicted branches. The interface of our system allows novices to design reasonably natural-looking trees quickly and interactively as compared with the interfaces of rule-based systems designed for expert users (e.g., L-systems).

1. Modeling Process

Figure 1 shows the entire modeling process using our system. The user begins to model a 3D tree by sketching a simple 2D tree by dragging the mouse (a). A pair of strokes represents a trunk or a branch. When the user rotates the model with the right button, the system generates a 3D tree (b). Branches are spread uniformly in 3D space as each pair of neighboring branches makes an approximately equal angle.

We implemented strokes for editing 3D tree models. A stroke intersecting a branch once cuts it. A stroke intersecting a branch twice erases it. The user can also add a branch to the existing model. The difference between (b) and (c) is that the upper two branches have been erased and a small branch has been added to the bottom-right branch.

Sketching is a very intuitive operation for novices, but it is extremely cumbersome to sketch all the branches on a tree. We therefore implemented a prediction function inspired by [Igarashi et al. 1997]. Our system automatically generates predicted branches around a clicked-on branch by scaling and copy-pasting the existing child branches. For example, by clicking on the trunk in (c), predicted branches are generated around the trunk as in (d). The prediction uses the information on the two branches that are already on the trunk. Our system implements eight kinds of prediction patterns [Weber and Penn 1995], such as “conical”, “spherical”, and so on. For example, in (d), branches are predicted using the conical pattern. If the user clicks on the trunk again, the system performs an alternative prediction using a different pattern. Alternatively, the user can select some of the predicted branches by clicking on them or drawing a circle around them, and the selected branches then become part of the existing 3D tree model (e). The user can also generate predicted branches around another branch with a child branch. In (f), the user clicks on the bottom-right branch and selects all the predicted branches (g).

By clicking on a branch twice, the user can propagate the same branching style for all other branches belonging to the same generation; (h) shows the result of clicking on the bottom-right branch twice. The user completes the operation by selecting the predicted branches (i).

The user can also add planar polygons representing leaves to terminal branches (j).

2. Results

It took approximately one minute to model the tree shown in Figure 1. Figure 2 shows example trees designed by the author using our system. We assigned appropriate texture images to leaf polygons. We spent approximately 30 to 90 minutes to design each of these models. We also asked test users to create original tree models, and examples are shown in Figure 3. They spent approximately 5 to 20 minutes to design each of these models.

This sketch presents our system for modeling 3D trees. Our system is interactive and intuitive, and our experience shows that novices can use it to model 3D trees freely and creatively.

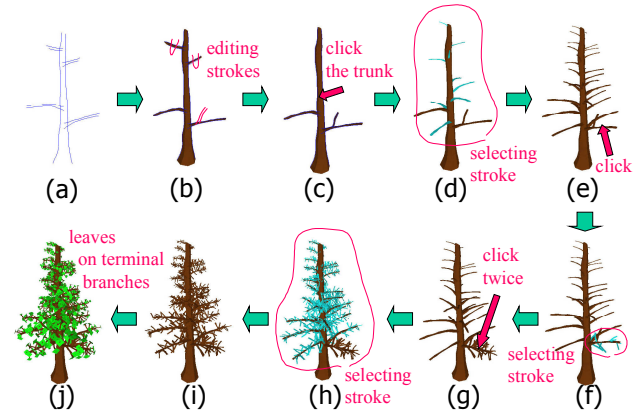


Figure 1. The modeling process using our system



Figure 2. 3D trees designed by the author



Figure 3. 3D trees designed by test users

References

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*e-mail: makoto21@ui.is.s.u-tokyo.ac.jp

†e-mail: takeo@ui.is.s.u-tokyo.ac.jp