Artistic Direction of Foliage (sap_0404)

Amaury Aubel, David Allen
DreamWorks Animation SKG

1 Abstract

We introduced in our production pipeline a procedural system to model trees that allows a high level of artistic direction. The central idea is to recognize that a good part of the artistic direction concerns the canopy's silhouette and the way it breaks up (Fig 1).

Fig 1: Original Artwork

Getting the canopy shape right can be quite time-consuming in rule-based modeling tools. One often has to spend considerable time tweaking the parameters and random seeds of rules before getting a close enough canopy shape. This is usually followed by a series of pruning operations to get the final look.

In contrast our approach is to sketch the canopy shape using a collection of simple geometric primitives and do most of the artistic iterations at this stage. Our procedural modeling system then fills the created canopy shape automatically with realistic-looking foliage elements.

2 Canopy Modeling

The main trunk and primary branches are first modeled by hand. We then assemble simple primitives such as spheres to create the shape of the canopy. We start by placing larger primitives to get the overall look. In a recursive fashion, we then use smaller primitives to capture finer detail.

Fig 2: Sketching the canopy

Due to the simplicity of the process, artistic notes regarding the density and arrangement of the canopy can quickly be addressed. It also facilitates the creation of variations for background trees by simply adding/removing/transforming base primitives.

We finally color code the primitives to create regions (Fig 2) that our procedural tools interpret as blending instructions to create natural foliage elements of like regions.

3 Foliage Generation

The canopy shape is sampled and converted to a dense point cloud. We derive a “potential” field by considering each point in this cloud as a radial emitter. This field gives us a good estimate of the desired foliage density. Similarly, the negated gradient of this field is a vector field that generally describes the preferred direction of growth for foliage (towards the canopy boundary). We thus convert the geometric representation of the canopy to an “implicit” formulation.

We then use a rule-based system [Tartaglia 2006] to grow branches, leaves and flowers. The rules rely heavily on the density field and its gradient. We can for instance favor the generation of branches in regions of high density, force branches to grow mostly towards the canopy boundary, adjust the leaf color based on the density, restrict the growth of flowers to low-density regions (that is, close to the canopy boundary), etc. We also use the gradient to provide an additional lighting normal [Peterson 2006].

In practice, we also compute a local density field based on the color coding (Fig 2). Thus we can have both local and global growth rules. This proves crucial for local adjustments in one region without perturbing others.

4 Applications

We have found that this system fits naturally into a production pipeline. We were able to model a wide variety of trees using this tool: evergreens (Fig 3), maples, cherry and peach trees, bamboo, sedges, birches, etc. The main limitation comes from the type of canopy one can represent with simple geometric shapes, e.g. certain tropical tree varieties that have very large leaves could not easily be maintained within the desired volume.

Fig 3: Rendered tree

TARTAGLIA, B. WILSON, R. OLCUN, T. PETERSON, S., GIBBS, J. 2006. A Procedural Modeling Worflow for “Over the Hedge” Foliage, Siggraph Sketch.

PETERSON, S. and LEE, L. 2006. Simplified Tree Lighting Using Aggregate Normals, Siggraph Sketch.