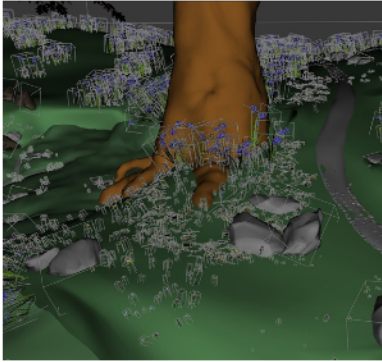


Kami Geometry Instancer: putting the “smurfy” in Smurf Village

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1 – Introduction

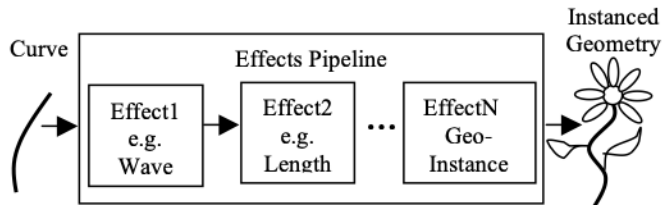
The ability to populate an environment with natural-looking visual “clutter” such as complex vegetation is often instrumental in creating a believable CG world. For The Smurfs, where their well-known Smurf Village would need to hold up to both wide and close-up shots, it would have been a nightmarish undertaking if every flower, leaf, mushroom, or blade of grass had to be hand-placed. Our Kami Geometry Instancer empowers artists to procedurally generate art-directed geometry of any kind.

Kami is our core instancing pipeline to generate and deform simple primitives like curves (for fur, hair and grass) as well as arbitrarily complex hierarchical geometry. This typically involves a 3 step process consisting of Population, Interpolation/Growth, and Final Instance Generation.

2 – Population

The first step determines where to create instances on a surface (Polymesh, Subdivision or Nurbs) based on a user-supplied density. Typically an artist paints maps to identify areas where a certain variety of flowers or mushrooms should grow. These maps can also be generated by proximity to objects (such as weeds growing near trees or rocks) or based on terrain. Hand-placed instancing is also supported for full control. Furthermore, clumping can be assigned at this stage to create hierarchies of bundles of instances (such as clumps of grass within clumps of weeds). All this information is calculated once, and then cached and re-used in all shots.

3 – Interpolation/Growth



This step creates a curve in every instanced location, either straight with a default length, or by interpolating its initial shape between user-supplied control curves and clump center curves. The growth process then fully leverages our “Effects Factory” [1] to allow the user to easily give it shape and art-directed random variation. Here artists can layer effects to modulate the instances’ length, bend, orientation, etc., including animated deformations like wind or being pushed away by surfaces (such as characters walking through vegetation). The interpolation step is done entirely on the fly at render-time, but can also be cached for faster re-rendering.

4 – Final Instance Generation

Deciding whether to generate simple curve primitives or complex geometry is simply provided by another effect in the stack called “GeoInstance”. Each curve that comes out of the growth step can be assigned a choice of instances. Any of our modeling assets can be used as an instance, so the show was able to independently model and perform look development on assets knowing that they would work seamlessly within Kami. Multiple GeoInstance effects can be used simultaneously, where the user can decide whether to pick randomly from a supplied list of assets, or assign them explicitly. For instance, one area could have a combination of 60% of grass curves and 30% of clover or weed geometry, while another might have a subset of three different kinds of flowers.

The instanced geometry can be deformed to match the shape of the curve driving it, which in turn can be manipulated with a large set of combing tools during look development, and a dynamic curve solver and hair motion editing pipeline for powerful animation control in shots, when vegetation needed to interact with any of the Smurfs. The final results can be interactively previewed in OpenGL both in Maya and Katana, our lighting package. Automated screen space LOD optimization of the instanced geometry and frustum culling can be turned on to improve memory footprint and render times.

5 - The Payoff

Leveraging on the rich set of integrated pipeline tools for placement, animation and manipulation of final hair curves has proven invaluable in instancing arbitrary geometry. Providing a powerful GeoInstance effect has made it easy for artists to quickly generate a desired, rich environment with varying geometries. The flexibility of the approach has improved layout time, and made it possible to quickly change the look when required by our clients. We think that it is this implementation and integration which sets our system apart from other similar approaches such as XGen [2].

5 – References

[1] A. Bruderlin, F. Chardavoine, “Hair Effects Factory within a Digital Hair Production Pipeline”, ACM SIGGRAPH Asia 2009 Conference, Technical Sketch, December 16-19, 2010.

[2] T. V. Thompson, II, Ernest J. Petti, Chuck Tappan, XGen: arbitrary primitive generator, ACM SIGGRAPH 2003 Conference, Technical Sketch, 2003.

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