

The Creation of Realistic Effect CG Shot based on Houdini

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Abstract

This article explains how to use Houdini to make realistic effect scenes. The author describes the ideas and processes for achieving the effects of cell divisions. The article explains in detail the creative ideas and technical realization process of the work, and summarizes the creative work of Houdini CG.

Keywords

Film and Television Special Effects; Realistic Effects; CG; Houdini.

1. Introduction

CG, the abbreviation of Computer Graphics, is the general term for all graphics drawn by computer software. Film and television special effects are an important part of the CG field. In recent years, the domestic film and television technology has developed rapidly, and CG effects have brought more possibilities for film and television, and also created more movie-watching experience for the audience. The proportion of CG special effects shots in film and television works is getting higher and higher. Among the many CG creation software, Houdini can be described as a dark horse. With nodeized and programmed operations and realistic effects, it far surpasses other 3D special effects software in the field of special effects production. From modeling to material to rendering, the entire production process provides the possibility for many difficult-to-achieve effects. As computer hardware continues to improve, resource sharing continues to optimize, and software update iterations are gradually accelerating. From the annual Houdini Demo Reel, it is not difficult to find that Houdini is more powerful and the effects presented are more realistic.

The author analyzes the idea and process of using Houdini software to create cell division special effects shots from the three processes of cell model production, cell division animation, and cell material production. The effect is shown in Figure 1.

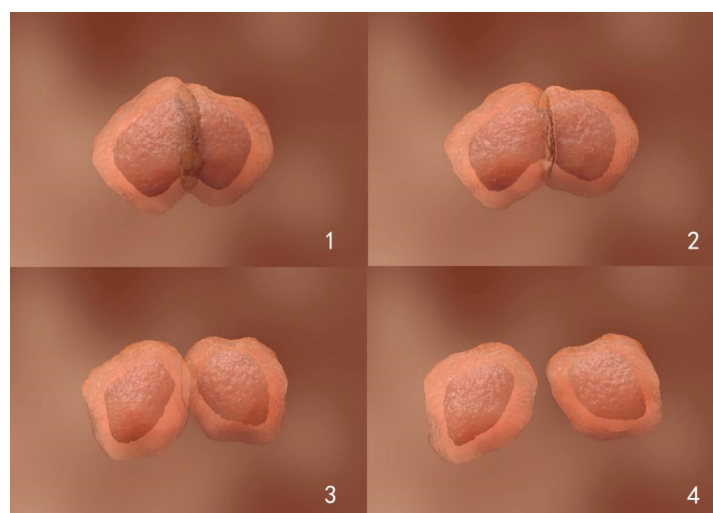


Figure 1. The special effects shot of cell division based on Houdini

2. Cell Morphology Production

The process of cell division refers to the process of mitosis on Baidu Encyclopedia. Create a Geometry node and name it cell_setup, enter the geometry of the node to create a model. In the first creative scheme, we use a sphere as the basic model for production, increase the number of segments of the sphere, and create a Mountain node to increase the noise details. The model is centered on the Z axis, divided into two parts, and the cell center is extracted. During the grouping process, it was found that after the sphere was cut, there would be a part of the surface interspersed, the model could not be completely separated, and there were always surfaces connected together. After trying several basic models, we decided to use the Platonic Solids node. The graph created by this node is called a Platonic solid, also called a regular polyhedron. The node created by default is a regular triangular pyramid. We need to change the mode to a regular octahedron, and then use the Subdivide node to subdivide. After subdividing, take the Z axis as the center line to extract points, as shown in Figure 2.

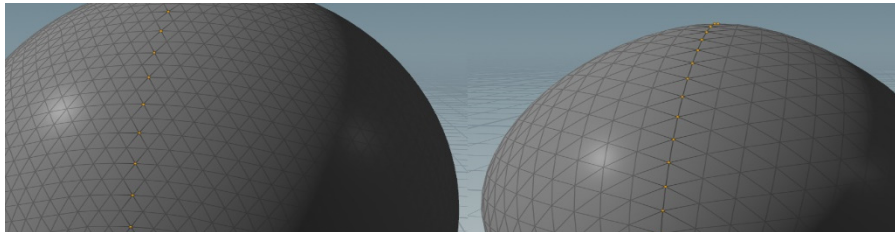


Figure 2. Extract points (the model on the left is based on a sphere, and the model on the right is based on an octahedron)

Since the cell will move around, we add a rest node in advance to record the original position. Set the cell_id, cell_id_prev, cell_id_split attributes separately for the model, and initialize the attributes to be simulated. Next, click vellum strut softbody in the vellum tool shelf to create a soft body. After the creation is completed, Dop solver and data export nodes will be generated under the Object level, and Vellum Configure Cloth and Vellum Constraints nodes will be created under the model in cell_setup. At this time, enter the Dop to create the ground for the solution. The created cell model will fall to the ground and bounce under the influence of gravity, which shows that the created soft body can be solved normally. Modify the bending resistance and damping strength of the Vellum Configure Cloth node to make the cells softer.

Create a new Subnetwork node and link it to an output port of Vellum Constraints. This output port outputs the model, and the second port outputs the constraint line. Enter the Subnetwork node and create two Output nodes to output the two cells generated during the division. Use the Group Combine node to calculate which points are on the left side of the center line of the cell. These points are the basic model for generating one of the cells when splitting. Delete the right point and fill the hole for the retained model. Use the Attribute Blue node to operate the P attribute of the turning surface to make it smooth. At this time, because the normal of the model is lost, the surface created when filling the hole is black, and a Normal node needs to be created to correct the normal of the model. Select the created node and execute Create Reference Copy in Actions to create another set of nodes associated with attributes. Here you only need to modify the group in the Group Combine to get the right cell. Because it is mitosis, the information of the two cells that are split is the same, which is also reflected in the production of Houdini. The production effect is shown in Figure 3.

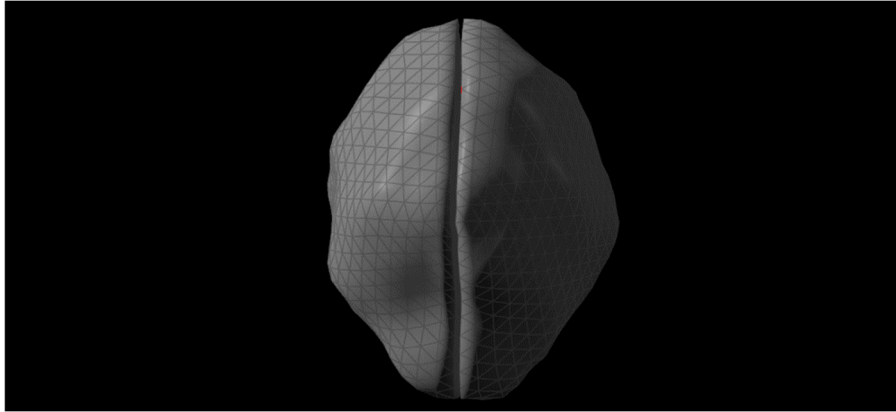


Figure 3. Single cell division

3. Cell Dynamic Effect Production

After setting up a single cell division, you can perform division simulation and multiple division production in DOP. Enter the DOP and delete the ground and gravity field created before. Create a SOP Solver node and connect it with Vellum Source in parallel. Add the Attribute Wangle node in SOP Solver, and use the following code to set the cell division time and determine how many cells will divide:

```
@age_f += 1;
i@group_split = 0;
float init_split_age = chf("init_split_age");
int num_cells = detail(0, "cell_id_max", 0) + 1;
if (num_cells < 2) {
    @split_age_f = init_split_age;
    if (@age_f == @split_age_f) i@group_split = 1;
}
else {
    if (@age_f >= @split_age_f && i@split_stop != 1)
        @group_split = 1;
}
```

Among them, `init_split_age` is set to an integer constant of 50. When 50 frames are played, `num_cell` is less than 2, and the cell divides for the first time. A cell is divided into two, but it cannot move outward. Continue to add the For-Each Named Primitive loop statement to copy the Subnetwork node made earlier. When the splitting conditions are met, the splitting continues again, and it will be divided into two and four. As the number of frames increases, multiple cells divide. Before outputting the SOP Solver, the Normal node needs to be used again to correct the discovery.

In order to make the split cells have the effect of random movement, use POP Force to add a Noise force field. Add the POP Drag node and Vellum Source below POP Force and connect them together to form a resistance field, which produces the effect of cell peristalsis.

By observing the reference video, we found that the cell adhesion phenomenon occurs when it divides. In the output dynamics calculation, the cells are copied into a group, appropriately reduced, and used as the nucleus of the cell. When a cell divides, the cell nucleus also divides. Introduce the cell nucleus part into the For-Each Named Primitive loop, convert the cell nucleus into VDB in the loop, use VDB Reshape to expand the surface field, and then use VDB Smooth

SDF to smooth, then shrink, and then smooth. After this series of operations, the cell nucleus changes smoothly from the same texture as the outer skin of the cell before, and there will be an adhesion drawing effect during exercise. The finished effect is shown in Figure 4.

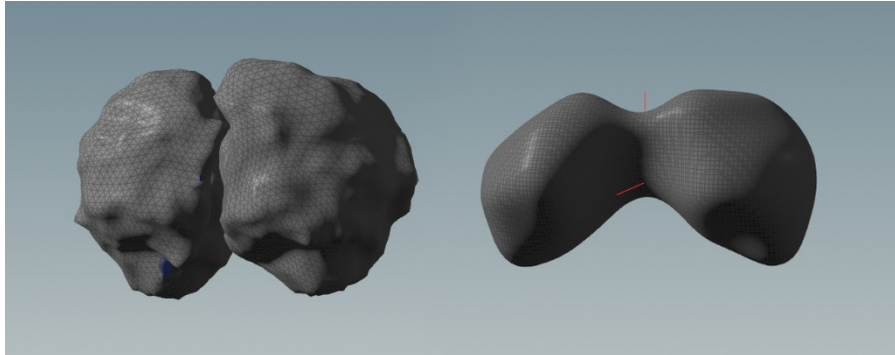


Figure 4. Cell nucleus division (the left picture is before modification, the right picture is the effect of polygon after being converted to VDB)

4. Cell Material Production

After the basic model and animation effects are completed, start to create the cell material. First, make a material for the inner nucleus of the cell: create a new default material Principled Shader, adjust the Base Color value to dark brown and give it to the nucleus model. After testing the rendering, it was found that the surface of the cell nucleus had less texture and lacked a sense of three-dimensionality.

Displacement mapping is a technique for creating bump details. It uses a height map to create the effect that a point on the surface of a geometric object is replaced with another location. This effect is usually to move the position of the point along the surface normal by a distance defined in the texture. It enables the texture to have the ability to express details and depth, and it can also allow self-covering, self-projection and presenting edge contours. Add a layer of Displacement Noise to the material, and use a small noise with positive and negative, noise frequency of 16, and intensity of 0.02, which can produce a layer of bumpy noise texture on the surface of the model. The advantage of this production is to increase the details without increasing the number of subdivisions of the model. The disadvantage is that if there is interaction between the model and the model, the piercing can be seen in the close-up shot. Considering the rationality of resources, this method is used to increase the surface details of the model.

SSS material is the abbreviation of Sub-Surface-Scattering, also known as 3S material, which refers to the translucent effect presented by the dispersion of light inside the object.

Use an intuitive example to illustrate its effect: aim the light of the flashlight at the palm of your hand in a dark environment. The palm is translucent, and the blood vessels in the palm are faintly visible. This is the 3S material, which is usually used to express translucent materials such as candles, jade ware, and skin.

The outer layer of the cell adopts the SSS property of the material. Use the default material Classic Shader in the old version of Houdini, set the default color to skin tone HSV (26, 0.377, 1), and turn on the Subsurface material properties. When the default mode of total reflection is used, a lot of color noise in the scene cannot be removed; after changing the mode to single reflection, the noise is improved significantly, and there is no obvious color noise in total reflection. The difficulty of SSS material is that it needs to cooperate with external factors such as basic color, light color, and light intensity to show a suitable effect. Otherwise, the color effect produced may be a mixed color of several colors or an opposite color. Finally, it is determined

that the SSS intensity is 5, the penetration distance is 0.9, and the color is orange-red HSV (10.9, 0.83, 0.9) material parameters, and the opacity is adjusted appropriately to achieve a semi-penetrating SSS material effect. Regarding the rendering settings, considering the time cost issue, instead of using the Physically Based Rendering mode with better rendering effect, the Ray Tracing mode with relatively faster rendering speed is used. Choosing a higher sampling accuracy requires more SSS output channels on the layer channel than before, which is convenient for further adjustment of the picture in Nuke later. The finished effect is shown in Figure 5.

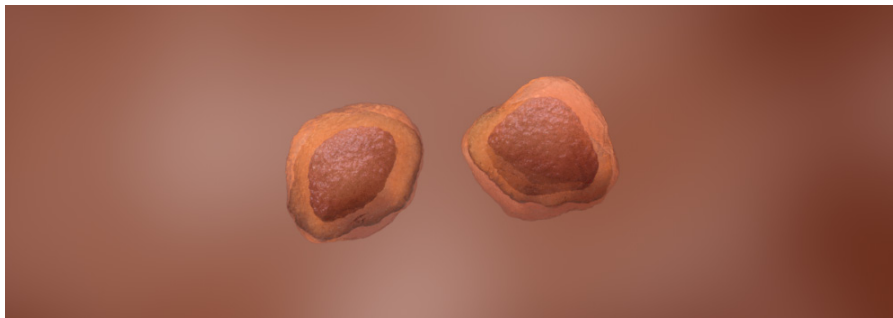


Figure 5. The effect of cell division completion

5. Conclusion

There are more and more super realistic special effects scenes in film and television dramas. These amazing scenes must be based on powerful post technology. Digital special effects technology has become indispensable in the field of film and television production.

Houdini is one of the best special effects production solutions at present, with the whole process production ability. The author used Houdini software to complete the production of cell division special effect lens. In the production process, the convenience of Houdini node operation is fully reflected. After the production, the effect modification is highly controllable. After the basic nodes are built, only a few node attributes can be adjusted to achieve the production of effect diversity, which greatly improves the production efficiency.

The biggest difficulty in the production process is rendering optimization, because the optimization method of each scene is different. In order to reduce the rendering time, a cache is generated for each scene and the points that are not visible in the camera are deleted, and the memory used is reduced, but the optimal effect is still not achieved. This also results in a vicious circle of insufficient scene details and longer rendering time. This also requires further research and improvement in the future to find the best optimization method.

In the Houdini software production process, a large number of nodes are used for operation. For beginners, there are many nodes that need to be learned, which increases the difficulty. The author expects to add more highly integrated node assets in future software update iterations to facilitate the production of effects.

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