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Dynamic Hair Effects

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Abstract

Creating three dimensional hair is still one of the hardest elements when creating characters. Problems occur because of the constant changes in the software every few years. A major goal is to create as realistic hair as possible in Autodesk Maya and to supply this detailed information on to other 3D artist. Techniques are researched and reviewed on how different hair systems are created, as well as how dynamic effects react on the moving hair.

Keywords: Hair, Dynamics, Dynamic effects, polygon hair, Hair System Shape, air, turbulence.



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1 Introduction

Hair research is one of the major areas today and the reasons for this are many. Normal human hair is very hard to model, animate, and render. There are various different approaches in how to tackle this problem. Therefore, the question is not only what program is best suited for the task but also how much time does it take to render? And also where is Computer Graphic (CG) hair research going in the future? And why is it so hard to create hair in CG when it should be one of the easiest things considering that CG software has been in this area for a very long time? One of the many problems is the process of creating hair has been dramatically changed in the software in the last few years. I will be researching the different methods on how to create and render hair in Autodesk Maya. I plan on including a description of attributes and how they influence the hair creation. Also I will look at the difference in the two methods and see which method provides the best results.

Methods that I will be researching and testing will be modeling dynamic hair with polygons and how dynamics effects react to the hair system. Methods of rendering will be software render and mental ray. And possible ways to enhance my renders will be created with software, such as Adobe Premiere, Photoshop, or After Effects. My main area of research will be to test dynamic effects such as gravity, turbulence and wind, as well as problems that may occur when using these effects. The reason for why I am going to research these areas is because it is not enough that the models have hair that appears realistic, but it should also move and behave realistic as well. I am also hoping to obtain realistic results and renders as possible when using dynamic effects and see the difference with polygon and paint effects hair.

I expect that I will obtain better results with a dynamic hairstyle compared with a polygon hair method, which I have created in the past. But on the other hand it would not surprise me if the render time would be greatly extended. Because of the limited time, I will not animate polygon hair with dynamics only research the method to create polygon hair. I also expect the dynamic hair based model would be slower and more difficult to create, however it would have realistic movements as a result. These realistic dynamic movements of hair are the focus of this research paper.

2 Previous research

There are many programs that provides hair modeling, such as Shave & Hair Cut from Joseph Altar inc. [1], Maya fur from Autodesk, Poser from Curious, and Sasquash from Warley laboratories [2]. They are all good programs for making and creating hair styles, however the user needs to have some knowledge before hand about the tools and attributes, since they are different in all the interfaces. And some times the commands are hard to understand and it requires some advance user skills. Today, we create computer generated characters or animals for a wide range of computer games and movies, therefore those characters that are created require realistic computer generated hair.

The first form of modeling hair was polygon based with transparency maps but since it did not really appear realistic a great deal of research has been put into different hair modeling techniques, because human hair needs to look realistic if we want it to look believable.

2.1 Basics of hair

The hair growing on our head has many features for it protects the head from heat and cold and defines the way we look, providing us with different hair styles. In general, there are 100,000 to 150,000 individual hair straws on a human head. The hair is geometrically, thin, curved cylinder. Depending on the individual, the hair can vary in width from 0.005mm to 0.09mm. The hair strands consist of 97% protein and 3% amino acids and other trace elements. Hair is a non-living tissue. The living tissue that creates and makes the hair grow is hidden inside the hair follicle. The hair grows in many different parts of the body and the only places where hair does not grow are the palms of your hands, your lips, and the bottom of your feet [6].

2.2 Theory

Therefore, why is it so hard to simulate human hair? [6] There are so many strands of hair in a human scalp, and if we suppose that a head has 100,000 hair strands and that each strand is made out of 32 cylinders with 32 faces this would mean that we have a total number of triangles that would be 102,400,000. This makes it very hard, if not impossible to render in a short amount of time. The strands of hair can have any degrees of waviness, from perfectly straight to kinky.

Other problems are geometric complexities of individual hair, and complex interaction of light and shadows among the hairs. The hair color itself (i.e its diffuse reflectance) can vary from white through grey, yellow, red, and brown to black, depending on the degrees of pigmentation. Hair also has a strong secular component.

Not to mention, how the hair acts when it actually is in motion. When creating hair in 3D, first the hair is modeled and shaped, then assign some dynamic properties, and then it is rendered. When modeling the hair, it should be model in such a method where the shape will define the movements.

In the making of the movie Matrix Reloaded [5], the CG artist started out trying to create hair with Maya's fur tool. Unfortunately, it did not provide them with the freedom to design and match the hairstyle of the actors; therefore they ended up rejecting it. Instead, they developed a new tool named Gossamer that is a set of plugins and scripts for Autodesk Maya. It has all of the same attributes as Maya fur but it allows the user more control over the hair. It also renders hair in real-time where the CG artist can actually view the hair before it is rendered.

The approach of Gossamer is by generating many very thin NURBS (Non uniform rational B-splines) passes, since mental ray did not support curve rendering. Then, they also implemented a

new and fast memory efficient hair primitive to produce faster rendering. Other memory saving measures was to subdivide hair into object portions and each portion was handled as its own object. Therefore, if a portion of hair is in the back of the head and it does not show on the screen, it will never render. In the process, they discovered an excellent algorithm, where rendering ten agent Smiths was the same as rendering just one.

The next problem that needed to be solved for the Matrix CG artists was the shadow and lighting problems. Both raytrace shadows and regular shadows still proved to be difficult to obtain soft and realistic shadows. Therefore, the solution they used was a volumetric approach that they called a shadow tree. What about the results from this method? Check out the Matrix movies to see the results.



Figure 1. Hair from Final Fantasy 7 (Advent Children) movie.

In FinalFantasy7 movie, all the characters hair was realistic and created with polygons (Figure 1). Since, they had gravity and fields applied to them, the hair behaved realistic, even though the whole move was anime based (Figure 2). Then, there is also the first Final Fantasy move (Spirit Within), which did not have anything to do with the game. They tried to create the characters as realistic as possible. And, I noticed that only one of the characters had long hair (Figure 2). In an interview, the producers in the movie said, “that if her hair would have been any longer, it would have taken a lot more time to render the movie.”



Figure 2. Hair from Final Fantasy (Spirit Within) movie.

2.3 Polygon hair development

The first option for the beginners and the average user is creating hair with polygons. This method has been around almost as long as 3D graphics itself and is still the most stable in creating and rendering hair even today. All games that have some type of hair on their models are most likely to be polygon based, because it is a very simple method in which to create hair. It also has a faster rendering time.

The question is how to create realistic polygon hair on a character? The first step, of course is modeling a head (Figure 3). Once the character is created, a decision needs to be made as to what kind of hair you want for your character to have, whether long, short, straight, wavy, curly, etc. This is an important planning stage in order to know how to create and design the hair.

Next, polygon strips are created and placed around the head in the directions that you want them to fall. Then, texture maps are created and assigned to the polygon strips (Figure 5, 6), creating almost realistic hair on the model (Figure 4).



Figure 3. Character head without hair.



Figure 4. Hair texture applied to the head.

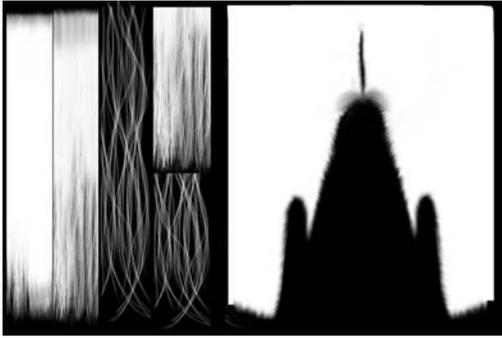


Figure 5. Alpha Map for the hair.

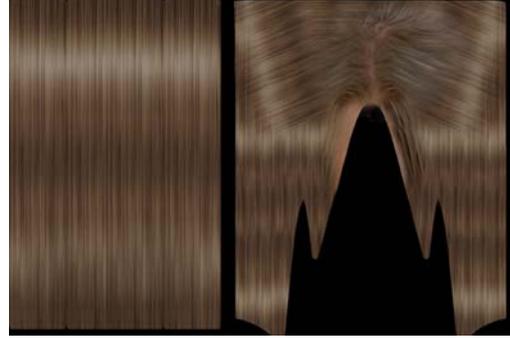


Figure 6. The hair texture map.

2.4 Creating polygon hair with surfaces

To start with a polygon strand is created in the length desired. The top edge, considered the area of the hair root, can be moved into the head; however it should not go through any other places or hairs. Then, copy the first strand and place the copies around half of the head by moving and rotating them in to place. Later you can copy and mirror the correct layout.

At this point, start modifying the strands where they appear correct and entirely fit the character's head (Figure 7). This method may take a great deal of time in the beginning. However once you have started to get the hang of it, it proceeds amazingly fast [3].

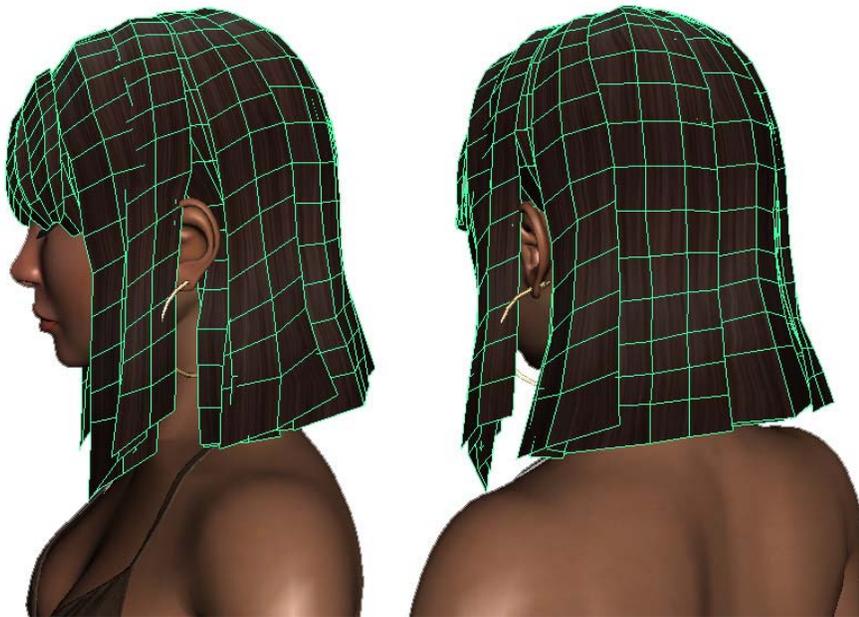


Figure 7. Polygon strands on the head.

I normally continue this process three times, one layer for the rough hair, one for the normal hair, and finally one for the hair strands. The advantage by creating hair with this method is that you as a user will have more control over how the hair is designed and how it is laid around the head. Also, the rendering time is shorten for if it would take twenty minutes to render a hair peace with dynamics (Maya hair system) then it only would take about three minutes with the polygon method.

There are many movies that have used polygon hair instead of dynamics. One of which is Final Fantasy: Advent Children. And by providing the polygon strands with dynamic attributes one can make them move and appear almost as real hair (Figure 4). However, the best usage area for this type of hair is probably best used in still images since it is not necessary to be as particular with the back of the head when creating a movie, where the character will be moving. When finished the character may look something like this (figure 8)



Figure 8. Finished model with polygon hair.

2.5 Polygon hair planes

A polygon plane is a flat polygon that can be shaped in many different shapes. With a transparency map on it and a texture, it is possible to use it in many diverse ways. With this technique it is possible to do grass and simple fur. This technique is very old but still reliable method that is often used in games and also has been used in many movies.

2.6 Specularity

This is basically how much an object should reflect light. When it comes to specularity and polygon hair this is a hard combination. Normally when I create polygon hair, I never use this option.

2.7 Texture

When creating hair with polygons, a texture map is required. The hair texture should cover the texture map in a method that it includes both the scalp and the hair strips. The color of the texture or the amount of strands is not that important for this is fixed by an alpha map.

2.8 Alpha map

With an alpha map, the possibility is available to choose where on a texture it would be visible or invisible. When creating an alpha map (Figure 9), the base texture would normally be used as a reference. And when creating hair strips, there should be three types of map areas for the hair, one for the thick parts, one for the thinner parts, and a final for single strands that provides more detail.



Figure 9. Alpha map applied to the left (no alpha to the right).

3 Dynamic hair Discussion

3.1 Previous dynamic hair with curves using paint effects

It is important to understand how the hair development has changed to this current dynamic process; therefore I am providing the previous basic idea behind creating hair with dynamics. When reviewing the current dynamic hair process, it will be evident that many changes have been made in the latest version of the software, which has changed during this thesis process.

This next method will be developed by using curves and paint effects (pfx) (Figure 10). This process begins by drawing all the curves around the head. The starting point is at the top of the head working down to the length desired. The curves are then moved and bent to the shape of the head.

Once the desired shape of the curves are in place, then paint effects can be use on the curves. Once Maya paint effects pallet is selected then the appropriate hair color to use is chosen and then applied to the hair curves [4].

To obtain the correct thickness and type of hair, attribute options can be manipulated until the desired results are satisfactory. The hair will appear more realistic.

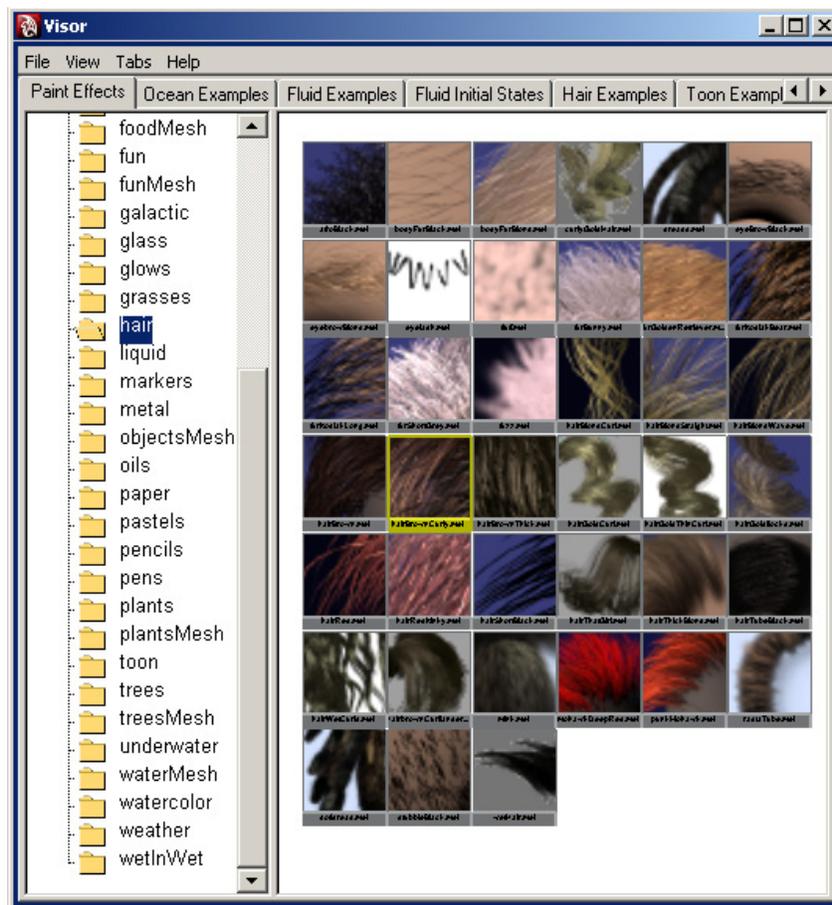


Figure 10. PaintFX.

3.2 Current dynamic hair

When creating dynamic hair in Maya, there are two options. The first is simply to click on the create hair example box, this will provide the CG artists with different hair style examples from which to select from and apply the hair on the entire head/object. Using a boldness map, it is easy

to delete the follicles that are not wanted. The second way is to paint the hair follicles on manually. One thing to remember though is that the more follicles that the object contains the more memory are needed to simulate dynamic movements and simulations.

A good method to avoid this problem is to create less follicles but paint passive follicles in between them. A passive follicle is less memory consuming and works by interpolating the movements to nearby active follicles. All the passive follicles can be painted even after the hair is styled. However, it can be problematic because the passive follicles interpolate where the hair can start pointing in directions that are not wanted. Therefore, there is both an upside and downside when using them in creating hair [10].

3.3 Base head model

The base head model (Figure 11) that I will be using for the Dynamic effect is a head and upper body, which I have created using Autodesk Maya 8.5. It will feature realistic textures with an sss skins shader. This model has been created before I started this research project; however it has been modified where it can be used to test a variety of hair styles and dynamic effects. I will be using a variety of other programs in creating the hair that needs to be tested, such as Maya 8.5, Adobe Photoshop for textures and enhancements, and Adobe Premiere for showing some of the results.

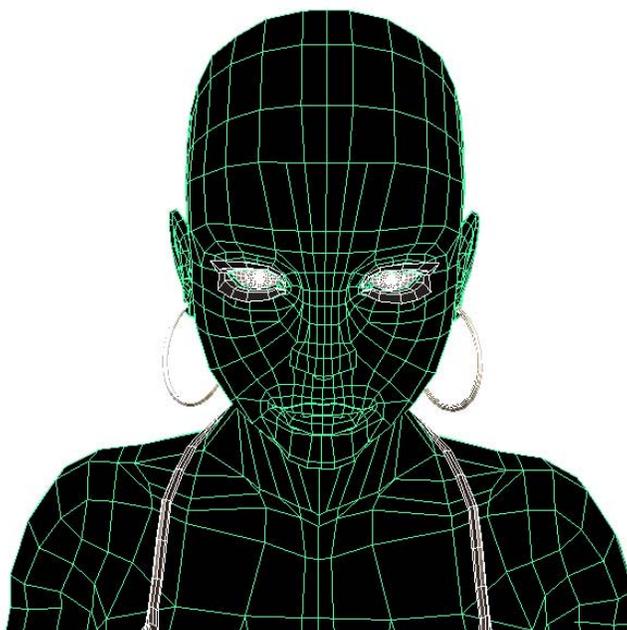


Figure 11. Base model no hair.

4 Dynamic attributes and options for hair

To obtain a better understanding of the attribute tools, I will provide a description of the attributes and how they work and the outcome of the settings. The list will not consist of all the attribute tools, only the ones that are most important when the user is trying to create realistic hair.

4.1 Set start position

This is an option that allows the artist to choose the starting frame for the animation. When a CG modeler is creating hair, all of the hairs will stand out in every direction. With this tool, he or she has the option at any given frame to say this is where I want my animation to begin.

4.2 Set rest position

This option is similar to Set Start Position but in this case the artist is choosing how the hair will look when the hair has relaxed and is not moving anymore. With this option the artist can create and manipulate a variety of hair styles [7].

4.3 Display

The artist has an overview of the different view modes. For example, the Display Current Position must be selected to actually view the hair. Next select play in the time slider and if nothing is happening and there are not any gravity effects on the hair, this might be because, the Display Start Position is selected. This allows control over the curves and can create constrains, as well as Set Start and Rest Positions.

4.4 Create constrain

When creating hair the artist might want to have more control over the hair and its position. There are a number of options and tools which provides for creating constrains that prevents the hair from moving in directions that are not wanted. The Constrain option provides the opportunity to also create a Collide Cube or Collide Sphere. These collide objects are used to prevent hair from penetrating or going through an object that is not desired, such as the upper body or the head as a good example [10].



Figure 12. Gravity effect and turbulence on hair (note collision is not perfect).

Things to have in mind when creating constrains (Figure 12) are that when you have created hair and apply constrains to the hair and plan on creating new follicles in to the same system, the new hair follicles will not effect the constrain. But that is usually not a very big problem if it is known in advance.

4.5 Modify curves

The artist has more additional options to choose and manipulate on how the overall hair shape will appear. The artist can curl the hair or assign it with a wave form if the artist would like it to be wavy (Figure 13). One other important tool that is available in this tool box is the Lock and Unlock Length option. This allows the user to choose if the hair can be stretched or not. When moving a CV point which is one of many that are on a dynamic curve, the hair shape will adjust so that it will continue to follow the hair without loosing its overall form.

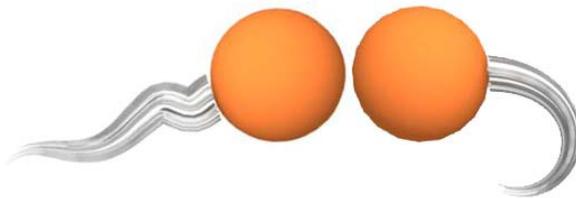


Figure 13. To the left Curl, to the right Bend.

4.6 Convert selection

This is an option that allows the user to convert the current selection to either a of attributes: Follicles, Start Curves, Rest Curves, Current Positions, Hair Systems, Hair Constraints, or End CVs.

5 Hair system shape

Before we start to create the hair and test different types of effects on it, it might be an excellent idea to have knowledge on a number of main tools and how they affect the hair. Unlike the other tools that are available to create the hair design, these are tools only exist in the Hair System Shape option section. Meaning, these are the tools used to change the overall appearance of the hair [9].

5.1 Display quality

This option is excellent to remember when designing hair. When an artist is working with hair, the animation and simulation time can be overwhelming. With this option the artist can lower the display quality where only ten percent of all the hair is showed on the screen. However, the hair that is showed on the screen is one hundred percent when rendering.

5.2 Clump and hair shape

Here are some good options on how the artist wants their hair to look like. The artist can here choose how many hair strands every CV curve will have and how thick the all the hair strands shall be. The hair can be thinned similar to a hair dresser where all the hair strands will not have equal lengths. Therefore, the hair appears more realistic and natural. There is also the option to decide the volume of the hair or if the hair is to be flatter. And finally, there is the alternative of selecting the amount of subsections. The bigger subsection, the smoother the hair appears to be.

5.3 Clump with scale

To obtain more control over the hair tips, the hair shape is determined by the width of the hair. The graph provides selection to the overall width on the whole hair system. The left side of the graph is the root of the hair and the right side is the top. For example, this tool is excellent to use if the artist wants spiky hair or maybe the artist wants the tip of the hair to be wider.

5.4 Hair width scale

This tool is simple to use. It determines how thick the root or the tip of the hair should be. Using another graph, one can select the overall thickness of the hair on the whole hair system. The left side of the graph is the root and the right side is the top. Since there are many different nationalities, all hair on individuals appear different for some have thicker hair while others have thinner hair. Or maybe the hair does not seem to look good from far away or even up close. Then using this tool is definitely recommended [7].

5.5 Clump curl

Does exactly like it sounds for it causes the hair to clump together. Using this graph, a modeler can decide how much curl to assign and where on the overall hair to put it. The hair can be curly only at the bottom of the hair or on just the tips. Like so many of the other options, this tool is affected on how many sub segments that are chosen. More sub segments provides an improved result, however the simulation time will become heavier.

5.6 Clump flatness

This tool has the ability to flatten the hair which is fine for some occasions. Also this tool is graph based and has the root on the right side and the top on the left.

5.7 Dynamics

The dynamic section provides the ability to control the stiffness in the hair. Depending on how hard you want your models hair to be, there is a graph that works similar to the other graphs that we have discussed above.

Other options are forces where changes can be made in settings, such as gravity, drag, damp, friction, mass. These are all good controls that allow for control on how the overall hair will behave without any outside interaction. Perhaps the designer wants to create hair that behaves as if it is in outer space, therefore just simply lower the gravity. Or if the hair should behave as if underwater then simply lower the gravity and increase the drag. An underwater current can be added with the turbulence option and increasing the intensively. Of course, more effects with the Hair System Shape can be achieved than controlling hair. In creating an octopus or a jellyfish, the hair system would be an excellent tool to use [7].

5.8 Collision

This tool is also described by its name. This option is available to keep the hair from colliding with any object such as a head. There is also an option that offers a choice to set where the hair can self collide. Therefore, the dynamic strands will collide with each other instead of passing through each other, which is normal in real life circumstances. One useful option is the Collide Ground. For example by clicking on this option, the Collide Ground tool acts something similar to a mop cleaning floors or a character with really long hair where the hair strands will collide with the ground.

5.9 Displacements

The displacement tools are similar to the Hair Curling tool. This tool can be used to create displacements that can make flat hair appear curlier. In my opinion even if designer decides to create flat looking hair or curly, always increase the curl and curl frequency just a little. This provides the hair with more realism since in real life there is nothing similar to one hundred percent flat hair. This tool is dependent on hair width. If the hair is thick, the displacement acquires a higher effect, which increases the rendering time considerably.

5.10 Shading

The next step is the hair texturing tool. In the shading tool box, the overall color can be changed in the entire hair system. This is accomplished with the hair color box. However changing the hair color is not the only thing in the hair shading box. As in real life many people color their hair and when it grows out the old hair color shows through. There is an option with the hair Color Scale that can be selected as to what shading color the hair should have. A graph is used for accomplishing this process. And there is of course a specular tool that allows for shininess on the hair; what color the shine should be, and how strong it should be. However if you want a variety of colors in the hair then a useful tool is the Color Randomization. And even if you really do not want a lot of different colors in the hair, it can still be a good idea to increase this option a little. This may provide the hair with more realism since normal colored hair is not entirely one single color.

5.11 Anisotropy

In the field of CG, an anisotropic surface will change in appearance as it is rotated in its geometric normal. In Maya there is a shader that does this, the Hair Tube Shader. When creating hair with the Hair System Shape, there is no need to be concern about this shader, unless the hair for some reason needs to be converted into polygon curves. Then the Hair Tube Shader will be created automatically. Converting the curves to polygon is a good way to overcome the light linking problem, however the display quality can no longer be changed. Therefore, the scene may

become very heavy and be hard to work with or render. The attributes and tools in the Hair Tube Shader is very similar to the Hair System Shapes tools so learning them is no trouble.

I had however no real time to test this shader and explore it in depth since that was not my goal and the scene would have had become too heavy to work with and render.

6 Rendering and lighting options

The next procedure to look at is rendering and lighting in mental ray. Why should mental ray be used and what options/attributes should be used to achieve the best render results?

In general, I find Mental Ray to be the best renderer in Autodesk Maya, the reason is Final Gather. It allows the lights to bounce around the scene and provide a realistic texture on the object that normally could not be able to achieve in the computer. Final Gather in combination with Ray Tracing will provide excellent results in Maya. In most cases, only a spot light is needed with these options to obtain a high quality rendered image. Therefore combining the above options with Image Based Lighting, an even better environmental result will occur.

Unfortunately rendering hair is not that easy in Maya and using Final Gather can mess up the hair a lot. The problem that occurs is that when rendering with Final Gather the hair gets all white even if specular is down to zero. The only solution that I have found to work is to go in to Hair System Shape Options and under Mental Ray and turn off Final Gather receive.

6.1 Image based lighting

Image based lighting is a way of simulating light that is emitted from an infinite distance. With a texture on a sphere, the object inside the sphere resaves colored highlights and other effects from the texture. With this method very realistic results can be achieved.

6.2 Texture

When creating hair with polygons a texture map is required. The hair texture should cover the texture map in a method that it includes both scalp and hair strips. The color of the texture or the amount of strands is not that important for this is fixed by an alpha map.

6.3 Alpha map

With an alpha map, there is the possibility to choose which sections on a texture that should be visible or invisible. When creating an alpha map, normally the base texture is used as a reference. And when creating hair strips, there should be three types of map areas for the hair, one for the thick sections, one for the thinner sections and a final for single strands that provides more detail for a realistic appearance.

6.4 Lights

A scene created by default has no light, therefore if rendered at this point. The output would only be a black rendered image. To achieve a lighted scene, a light needs to be created. There are many different types of lights in Maya and they all have different attribute abilities. It is important to know what kind of light to use to develop the best results.



Ambient light is a background light that has no particular location or source direction. Ambient light is a good light source to simulate sunlight or a hazy day. This light is used to increase control over your scene and is good to change the overall color of the area.



Directional light is a light type that sends rays in an even parallel direction. This light source is good to simulate light that comes from a long distance, such as the sun.



Point light is a light source that spreads light rays in all directions similar to a sun. This light type is excellent to simulate a sun, light bulb, or a lens flares.



Spotlight performs similar to a real spotlight in real life. The light is aimed at the area where the illumination is needed. The cone can be scaled to change to increase or decrease the light in the area that needs to be illuminated for the best results. This light type can also be used to project image maps.



Area light acts in a similar method as a spotlight. It sends its light rays in both straight, forward, and to the sides. It is pointed at the area which needs to be illuminated. The difference in this light is that the render time is increased, because it creates a higher quality of lights.



Volume light is a bit different from the other light sources. The other light sources listed above spreads their lights from infidelity point sources; however the volume light is constrained to its volume. This light source can be used in a variety of techniques, such as to remove light (negative light) or enhance shadows.

When it comes to lighting up human skin, I find it best to have a light source with a blue color (spotlight). A secondary light is created which lights up the background (ambient light). And depending on what render application that is used, the final outcome will appear different. And when lighting up hair a spotlight is adequate.

6.5 Shadows

In Maya, there are two types of shadows, depth map shadows and ray traced shadows. They work almost the same but in general ray trace shadows take a lot longer time to render unlike depth map shadows. Unlike depth maps, the shadows in ray trace are more accurate and often provide a realistic result. And depending on what kind of results the hair designer is after, the settings only need to be modified.

When it comes to shadowing human skin, I find it best to use ray trace shadows with a spotlight. However, shadowing hair is a bit different since using ray trace does not provide it with realistic detail. The best shading to use on shadowing hair is depth map shadows. To obtain the most out of these, Shadows Mid Dist should be turned off, and to enhance the quality Boi and Filter Size should be increased.

The only problem now is that since Maya still does not support Light Linking with hair it suddenly become more difficult to achieve good renderings.

6.6 Raytrace shadows



Figure 14. Rendered with Ray tracing shadows.

This is a shadow method that calculates the path of the light ray from the light source to its destination. This shadowing method is best used for producing realistic shadows similar to those in the real world. But render time is much longer and the image above took 8 minutes to render (Figure 14).

6.7 Depthmap shadows



Figure 15. Rendered with Depth map shadows.

Depth map shadows is a representation of the distance from the light to the surface it is lighting up. Using depth map shadows provides a very good result most of the times and a modest increase in the render time which took about three minute (Figure 15).

7 Getting started

Even before starting to create hair, it is important most of the time to have at least an idea of how to design the hair in the fashion that is desired. If not many problems might be encounter and a lot of headaches that could be avoided. The reason is there is not any high-quality hair styling tools. However, there are some various methods to create hair for objects. But before I describe these methods, the most important thing to remember before starting is the UVs. If the hair is going to be created on a Nurb face, this is not a problem. However if hair is going to be created on a polygon face, the UVs must be fixed or the hair will not appear as desired.

7.1 Creating the hair

One method of creating hair is to paint the hair follicles directly on the head and style them later. Another way is to simply click on create hair and it will flood the entire object with hair. This method has a Boldness map which will be needed. It can also be used on many other hair creating methods. A Boldness map acts more or less similar to an alpha map. A texture is imported that shows where there should be or not be follicles on the UV map. The final way to create the hair is to paint or create the hair on a separate object. This way is easier in my opinion, because there is only one object to concentrate on.



Figure 16. Rendered hair with Mental ray depth map shadows.

7.2 Styling the hair

This is the hardest part when it comes to dynamic hair styling (Figure 16). Simply because there is not any first-rate tools that can be used that are similar to real life. In real life, a hand would use a comb, hair spray, or moose. However since these are tools that do not exist in Maya, the CG artist must find another method. Tools that can be used for hair instead are the: Create Constrain tools, Set Start/Rest Positions, and Modify Curves tools [8].



Figure 17. The dynamic curves on the head (Display Quality 0%).

And there is also a tool, the End UV Curve that can be selected on the hair curves. With this tool simply select all End UVs and with the Lock Length too, it is easy to move all curves in the direction that is wanted to form the hair shape. Unfortunately, this is easier said than done. This is a very unforgiving tool but still a very good one. Another tool is to Gravity to help style the hair, as well as an Air Field to move the hair in to position [8].

The CG artist has to use some imagination when styling hair. One word of advice when it comes to styling the hair is to lower the Display Quality (Figure 17) or the simulation time might become time consuming. And also, the Interactive Playback is beneficial to use. This provides a method to make it easier to test the hair attributes and at the same time as Maya simulates the effects.

7.3 The fields



Figure 18. Air effect and turbulence on hair.

7.3.1 Air

This is a dynamic effect that provides the effect of wind or moving air (Figure 18). It is easy to increase strength, direction, and magnitude. However, the attribute that I did not find was turbulence in this effect. This is an effect that simulates random movements. Thus when it comes to using the Air Field on hair, sometimes it is recommended to go into the Hair System Shape toolbox, and increase the Intensity of the Turbulence to obtain a realistic effect. Especially when the goal is to make the hair appear as if in a storm or very windy weather.

7.3.2 Drag

This effect resembles a resistance field that makes it harder for objects, such as hair to move through it. Drag is like friction and tends to reduce speed of moving objects. This effect can be parented to the head and to some degree help to fake hair to hair collisions around the target.

7.3.3 Gravity

This field also performs as it sounds. It controls the gravity of any object or hair system that is needed. Direction and Magnitude can easily be changed and increased. This field is good to use when simulation weightlessness and can be combined with the hair system shape attributes to enhance any desired effect wanted. It is also easy to use this option to create a under water effect on hair.

7.3.4 Newton

This field is comparable to a black hole and planets in general. The closer an object is to the effect the more attracted it becomes to it. When it comes to using this effect on hair, it is similar to static electricity.

7.3.5 Radial

This effect is very similar as a Newton field except that it works in both ways. It works like a magnet and can either attract or repel any desired object.

7.3.6 Turbulence

This is an effect that causes random noise on objects that it affects. This is a good field that can be combined with the Air or Gravity Field to create for example under water effect.

7.3.7 Uniform

This is a field that pushes objects to it or from it in a uniform way. This tool acts similar to the Newton field except that the hair strands do not become pulled into one point in space.

7.3.8 Vortex

This effect pulls objects or in this case hair in a circular direction. This is a field that is best used when creating whirlpools or tornados.

Most of these fields have easily understandable field attributes. One attributes is Magnitude that is the strength of the field. And then there is the Attenuation that controls how much the strength of the field decreases as objects move away from the field.

8 Conclusion

Dynamic hair provides the impression that it is uncomplicated, but for some reason doing hair with dynamics is much harder than doing it with polygon hair. Why would that be? This is usually because most of the tutorials on hair are out of date with very few updates. And frequently most of them do not work on newer versions of Autodesk Maya. Therefore, which hair method is the best to use?

What is the main difference between these two methods? With the polygon method, there is a faster rendering time and manipulating the attributes will provide good quality results. However, the disadvantages are that it is very hard to achieve realistic hair. To achieve realistic hair, paint-effect/dynamic hair is superior by tweaking the options enough, as well as the render options. However, the render time can become excessive. In general, the render time for dynamic hair versus polygon hair is ten to twenty times longer. But I found a little trick that actually made the dynamic hair render a lot quicker, by turning off receive, rendering time was decreased greatly. Unfortunately, the hair loses some realism. Which of these two methods are best? This is a difficult question to answer.

As to which method would be the best to create hair, I would have to say it is totally up to the 3D artist. As a new beginner, I would first try to create polygon hair since it is faster to render and learning the different attributes that control the hair can also be good to know. However if you already know how to create hair with polygons and just can not achieve the appearance or results that is needed, then I would try creating hair with curves. This way after some extensive experimenting, the best realistic results can be accomplished.

The drawback with creating hair with paint effects dynamics is not only the render time for different renders react different when rendering the final product. For example, some hair dynamics will not render in Mental Ray, which can be very annoying.

Creating dynamic effects with the Hair System Shape turned out easier than I first thought it would be. Applying the different fields was just as easy, the only difficult part when it came to creating dynamic hair was to actually style the hair.

The last problem was the shadows since my aim was for realism. Only problem now was that the hair rendered better with depth map shadows and the skin looked better with ray trace shadows. Normally this would not be a problem but so far Maya still does not support light linking to the new dynamic hair system.

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