Tutorials
Hair & Cloth

AUTODESK®
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9

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7 Hair and Cloth

The following tutorials explain how to correctly use Hair and Cloth on your models to accomplish specific results. The Hair tutorials refer to applying different types of hair and fur, while the Cloth tutorials demonstrate the basic workflow to create pieces of clothing, and then tailor them to your model.

Features Covered in This Section

- Adding the Hair and Fur modifier
- Using a sub-object level to control hair placement
- Modifying hair settings, including material properties
- Rendering hair
- Using the Garment Maker
- Applying the Cloth modifier
- Locking points on the cloth
- Adding space warps and collision objects to the cloth
- Running a Cloth simulation
- Adjusting fabric properties

Files for This Section

All the files necessary for this tutorial are provided on the program disc in the *\tutorials* directory.

Before starting the tutorials, copy the *\tutorials* folder from the disc to your local program installation.

Hair

Hair Tutorials

The tutorials included in this section walk you through a variety of methods for using Hair.

Features Covered in This Tutorial

- Adding the Hair And Fur modifier

- Using a sub-object level to control hair placement
- Modifying hair settings, including material properties
- Rendering hair

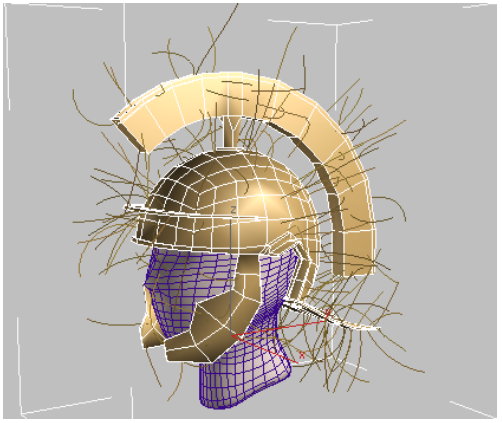
Tutorial Files

All the files necessary for this tutorial are provided on the program disc in the *\tutorials\hair* directory. Before starting the tutorials, copy the *\tutorials* folder from the disc to your local program installation.

Creating a Centurion Helmet

Add the Hair And Fur modifier to the helmet:

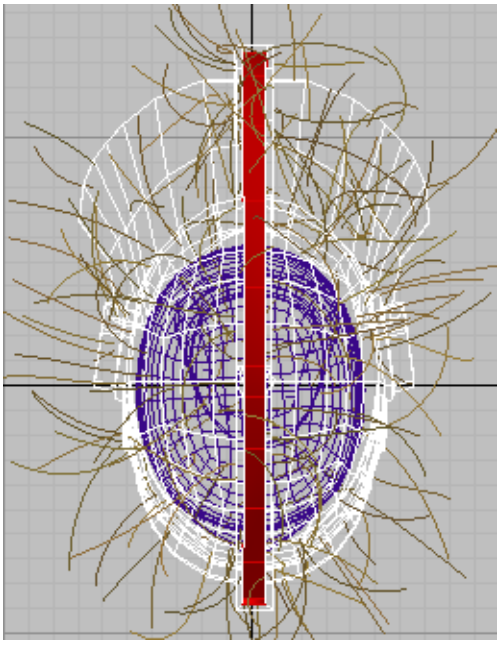
1. Open *helmet_hair_start.max* from your *\tutorials\hair* folder. This scene contains two mesh objects named *Head* and *Helmet*.
2. Select the *Helmet* object, and then go to the Modify panel and apply the Hair And Fur modifier. Hair And Fur is a world-space modifier (WSM).



Hair emanates from the entire helmet.

3.  The hair should grow only on selected portions of the helmet, so on the Selection rollout, click Polygon to go to the Polygon sub-object level.
4. Turn on Ignore Backfacing.
5. Select the polygons in the groove at the top of the helmet.

 This is easiest to do in the Top viewport: use Arc Rotate to make sure you've selected all these polygons. When the selection is complete, press Shift+Z to restore the original Top view. (You might have to press Shift+Z more than once.)



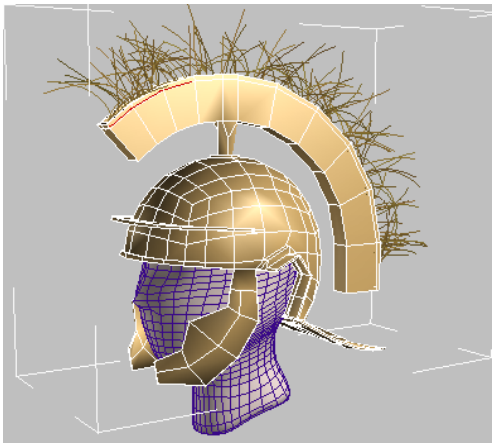
Selecting the crest polygons

Tip: You can use Ctrl+click (or drag) to add or remove polygons from the selection, and Alt+click (or drag) to remove them.

6. 

On the Selection rollout, click Update Selection.

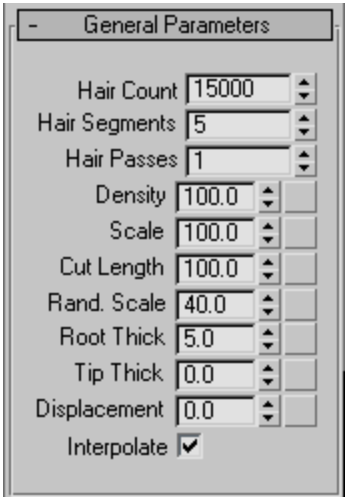
The hairs now emanate only from the selected polygons.



Hairs growing from the crest only

Modify the Hair general parameters:

1. Scroll down to the General Parameters rollout.



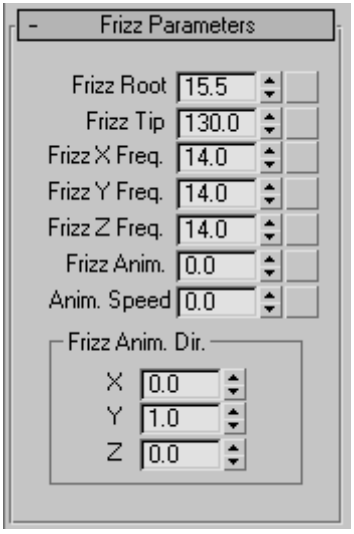
2. Change the hair count to **10000**.
3. Reduce Hair Segments to **4**. This value is the number of segments created along the length of each hair. Shorter hair needs fewer segments; longer hair needs more segments. Lowering the number of segments also reduces the amount of time it takes to render the scene.
4. Change the Rand(om) Scale value to **0.0**.

   For this example, the helmet hair is all the same length, without any random scaling.
5. Set the Root Thick and Tip Thick values both to **2.0** so that the hairs are the same thickness along their entire length.

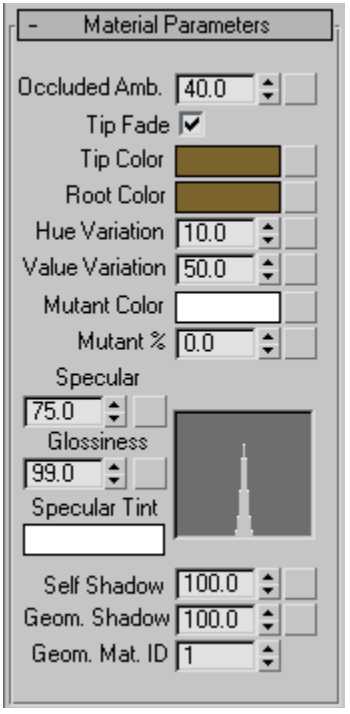
   Next you'll change the frizz and material properties of the hair.

Modify the Frizz and Material Properties of the helmet crest:

1. Open the Frizz Parameters rollout.



2. Set the Frizz Root and Frizz Tip values to **10.0**.
3. Open the Material Parameters rollout.



4. Select a bright, saturated red for the Tip Color and black for the Root color.
5. Reduce both Hue Variation and Value Variation to **5.0**.

   Because this is dyed hair, its color and texture are more uniform than natural hair. We want to add a bit of variety, but not much.
6. Leave the Mutant % value at **0.0**.

   Mutant hairs are randomly selected and receive the color assigned. Mutant hairs are present in natural hair; as we age, we have more and more mutant gray or white hairs. However, the foot solder's helmet plume will not age (they used dyed horsehair), so you'll leave the mutant hairs out for now.

Render your scene to view the hair:

The Hair And Fur modifier requires at least one spotlight in the scene to render shadows.

1. From the right-click quad menu, choose Unhide All to unhide the lights in the scene.

   Two omni lights for general lighting and one spotlight for the Hair And Fur modifier appear. The spotlight is set to render shadows.

   A Hair And Fur render effect is necessary to render hair, but this is added automatically when you first apply the Hair And Fur modifier to an object in the scene. Also, by default the render effect is set to automatically use all spotlights in the scene to illuminate the hair, so no don't need to take further action to adjust the lighting.

   You can now render your scene.

2. With the Perspective viewport active, render your scene (press F9).

   Note: You can render hair only in a Perspective or Camera viewport.

   Your centurion helmet should look something like this:

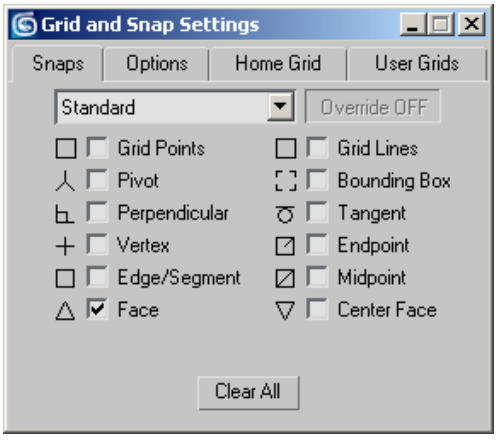
Rendered image of the helmet

Recombing the Helmet Crest of Hair

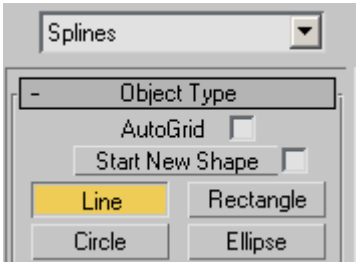
In this lesson you'll learn how to style the hair using the Recomb From Splines tool.

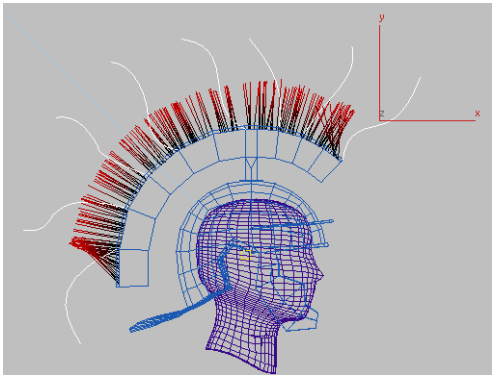
1. Continue from the previous lesson or open *recomb_helmet.max*.

2. Before you begin to draw the splines, turn on the Snaps Toggle (press S) so that the start of the splines begin at the roots of the hair. Also, right-click the Snaps Toggle button to open the Grid And Snaps Settings dialog, and on the Snaps panel, turn off Grid Points and turn on Face. Close the dialog with the X button in the upper-right corner.



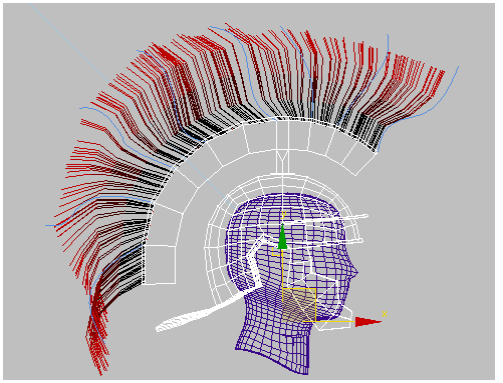
3. Starting at the front of the helmet, draw Line splines away from the head as illustrated below. Hair requires that all the splines are part of the same object, so after you draw the first spline, turn off the Start New Shape check box on the Object Type rollout.





Spline object to use for recombing

4. Select the Line object to make sure all the splines are part of the same object. If they are not, select the first line, go to the Modify panel, and at the Spline sub-object level, use Attach to attach the other lines.
5. Select the Helmet object, and on the Tools rollout, click Recomb From Splines. In a viewport, click the spline object.



The hair now follows the shape of the splines.

- Render the Perspective viewport to view the new hair.

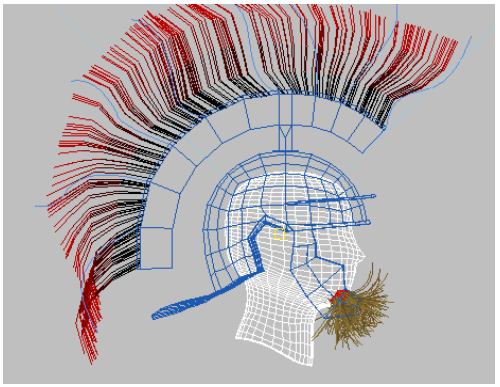
Hair recombed by splines

Adding Facial Hair to the Centurion

Now that you have the helmet ready to go, you'll add hair to the centurion's face.

1. Continue from the previous lesson, or open the file *recomb_helmet_splines.max*.
2. Apply the Hair And Fur modifier to the head.
3. Go to the Polygon sub-object level. Make sure Ignore Backfacing is turned on, and select the polygons at the base of the chin.

    As with the helmet, Arc Rotate can help you locate the polygons you need, and once you've made the sub-object selection, Shift+Z will undo the viewport changes.
4. Click Update Selection.



Hair as a goatee, with chin polygons selected

Use preset hair values:

1. On the Tools rollout, click Load in the Presets group.

The Hair And Fur Presets dialog appears.

2. Double-click the "clumpy-wet-brown" preset to apply it to the polygons.
3. Adjust the Perspective viewport so it shows a better view of the chin, and then render it.

   You now have fine, spiky hair growing from the chin.

The goatee before styling

Style the goatee:

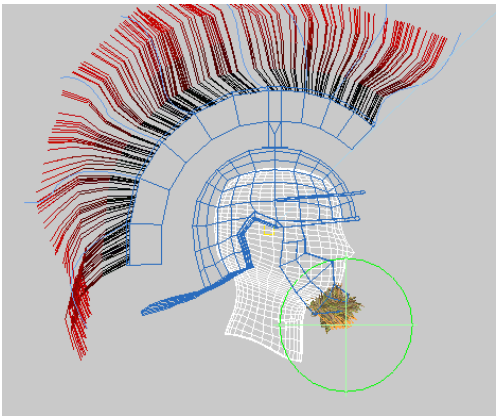
1. Open the Styling rollout and click Style Hair to turn it on.

   A green brush gizmo appears in viewports. In the active viewport, the brush appears as a circle, but it is actually a cylindrical region, as you can see in inactive viewports.

   Orange guide hairs also appear in the viewports, among the actual hairs. When you style hair, you are styling the guides. There are fewer guides than hairs, so this method saves performance time.

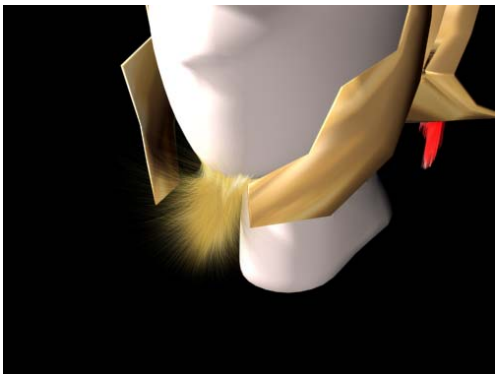
   Tip:  The Guides can be easier to see in viewports if you turn off Toggle Hair in the Styling rollout's Utilities group.
2. Make sure the brush is large enough to encompass the goatee. If you need to change its size, you can use the slider in the Styling group (below the Ignore Back Hairs toggle), or you can hold down Shift+Ctrl and drag the mouse.
3.  Click the Translate button to turn it on, position it over the goatee, and drag to straighten the hairs so they point away from the chin.

The Front and Left viewports are the easiest to use for this adjustment.



Goatee translated downward and away from the chin

4.  Click the Clump button to turn it on. In the Front viewport, place the brush over the goatee and then drag toward the right to move the guide hairs together until they come to a point (see the illustration below).
5. You might want to repeat the two preceding steps until you get a result you like.
6. When you are happy with the results, render the Perspective viewport.



The goatee after translating and clumping

The hair still frizzes out a bit too much at the tips.

Fix the frizz value:

- Go back and change the Frizz Tip value to **0.0**. Render the scene again to view the changes.

The goatee with tip frizz removed

Grooming a Dog

In this tutorial you'll use Hair to add fur to a dog model, and then groom the fur. The tutorial also covers preparing the model for automatically growing fur of different lengths by adjusting polygon sizes.

Set up the lesson:

- Load the file *dog_groom_start.max*. This is located in the *|tutorials|hair|* folder.

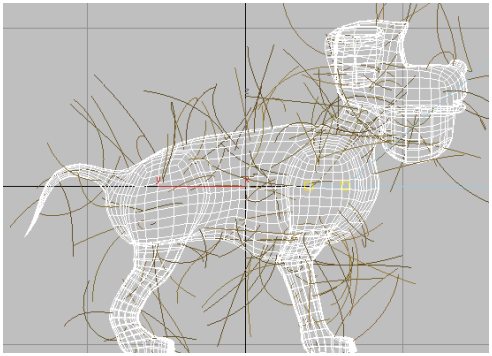
  This scene contains a cartoon dog model. The dog was created using the box-modeling method, and was then mesh-smoothed. This automatically creates smaller polygons where the hair should be shorter, such as on the legs.

Apply Hair and Fur and choose a preset:

1. Select the dog model, and then go to the Modify panel.

2. From the Modifier List drop-down > World-Space Modifiers category, choose Hair And Fur (WSM).

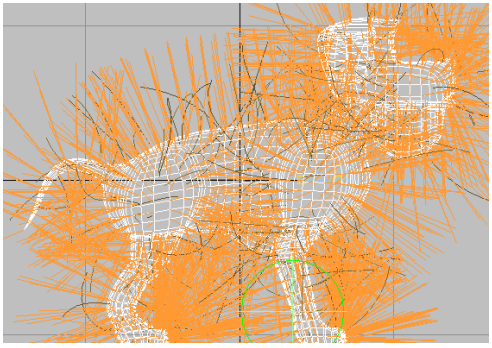
   The hairs appear as brown lines emanating from the dog model.



Begin grooming the fur:

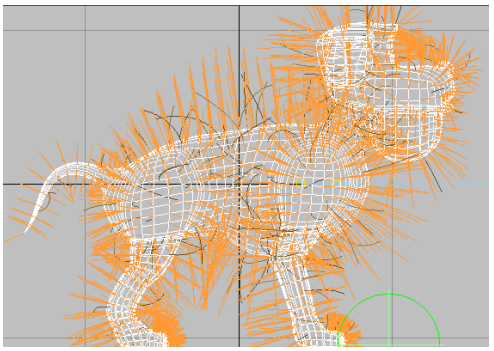
1. Open the Styling rollout, and click Style Hair to turn it on.

   A large number of orange hair guides appear in the viewports. By default, all the guides are standing perpendicular to the mesh surface, and are all the same length.



At the start, all the guides stick straight out.

2.  In the Utilities group, click the Attenuate button.

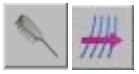


Attenuated guides

Attenuate makes the length of hair guides proportional to the size of the polygons they grow from. Attenuate is a useful tool in this case, because most dogs have shorter hair in areas with higher detail, such as the head and legs.

Use the Translate tool to brush the fur:

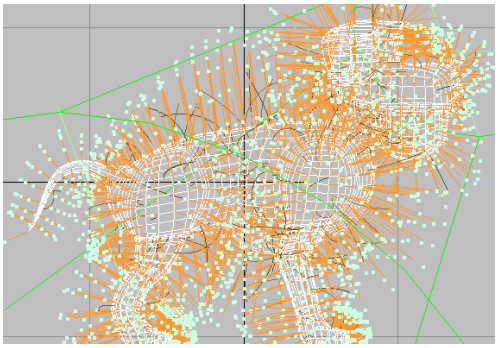
1. Activate the Left viewport, and press Alt+W to maximize it.

    When you turn on Style Hair, the Hair Brush and Translate tools are on by default. You'll use these to begin grooming the dog.

2. Increase the size of the brush until it is about a third the size of the dog. This is about two-thirds to the right on the Brush size slider (just below the Ignore Back Hairs toggle).

3.  In the Selection group, click the Select Hair By Ends button to turn it on.

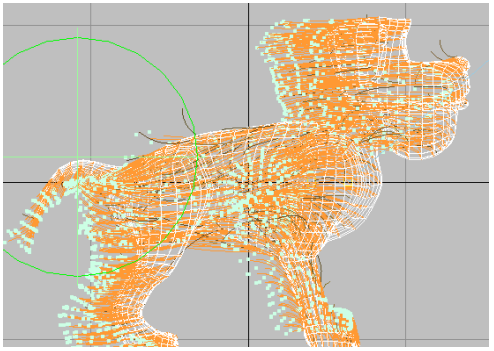
   The tip vertices of the hair guides appear in the viewport.



This selection option moves hairs by the end only. The effect is softer than Select Whole Guide, which is the default.

4. Position the brush over an area you want to groom, and drag the mouse to groom the fur in the general direction it should flow, away from the dog's face.

   Note: Don't worry if hair appears to penetrate the surface of the dog. You will fix this in a later step.

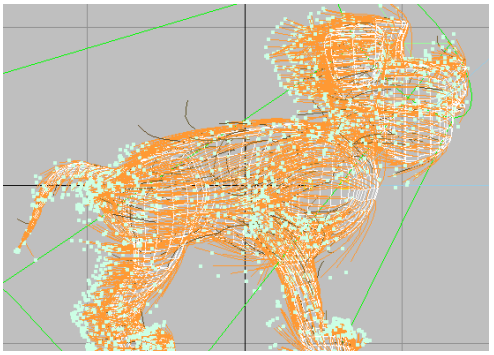


The dog after a first brushing

Because this is a big soft brush, you can get a fairly smooth transition from one direction to another. As you continue to groom, make the brush smaller for fine-tuning the fur.

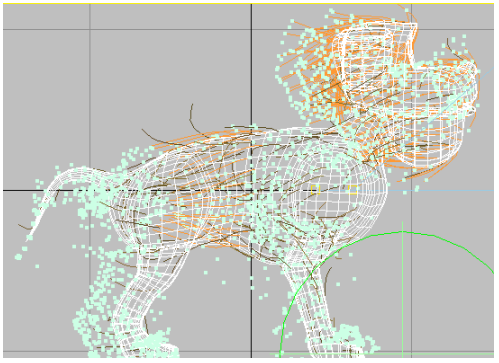
5.  In the Utilities group, click Recomb.

The Recomb tool snaps all the hair that you've just brushed to the surface's tangent, but it preserves the hair's length and overall direction.



Recombing "tames" the guides.

6. Repeat the two previous steps until you're happy with the general flow of the fur.

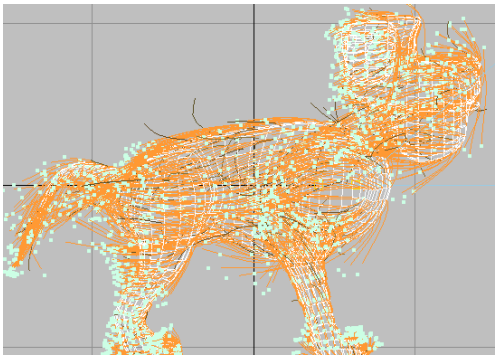


The dog after further grooming and recombing

Scale the fur to adjust its length:

1.  In the Styling group, click the Scale tool to turn it on. Reduce the size of the brush, and then go around the dog, manually adjusting the guide lengths. Dragging to the right increases hair length, and dragging to the left decreases it.

   The hair on the ears and legs should be a bit shorter, and you might want to grow the hair on the snout and tail out a bit.



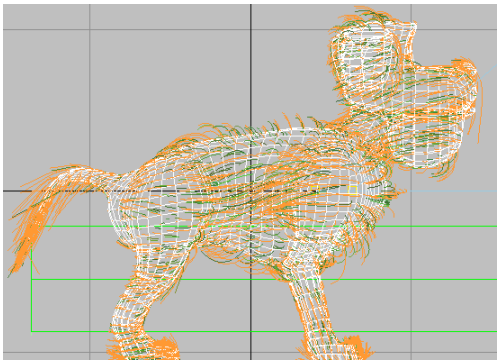
Scale the guides in places where the fur should be shorter.

2.  Click Recomb again.
3. Repeat the previous two steps until you like the result.

Use the Stand tool to make the hair stand out from the body:

1.  In the Selection group, click Select Whole Strand to turn this selection mode on once again. Then in the Styling group, click the Stand tool to turn it on. Position the brush over areas of the dog, and drag to the right a bit to puff the hair away from the body.

   Using Stand with the brush pushes the hair away from the skin.



Use the Stand tool to make the guides stick out more.

   Natural fur usually stands out at about 60 degrees from the surface; you can also use the Translate brush at a side angle to do this. For this tutorial, you're modeling a stuffed animal, so you can stand the hair out a bit more than might be natural.
2. When you're satisfied with the grooming, click Finish Styling to turn this button off.
3. Press Alt+W again to restore the four viewports.

Adjust the material settings:

This is a toy dog, so you can use unreal coloring to enhance the effect.

1. Open the Material Parameters rollout..

   The scene already contains two spot lights, both set to cast shadows in the form of shadow maps. Because the Hair and Fur render effect uses these by default, the spot lights will automatically cast shadows from the hair.
2. Set Tip Color to a medium green: R=**95**, G=**157**, B=**45**.
3. Set Root Color to a slightly darker green: R=**61**, G=**145**, B=**45**.
4. Set Occluded Amb. to **96.4** and Hue Variation to **40.0**. The fur shouldn't be too shiny, so set Specular to **8.365** and Glossiness to **71.28**.

Adjust other settings to make the hair like fur:

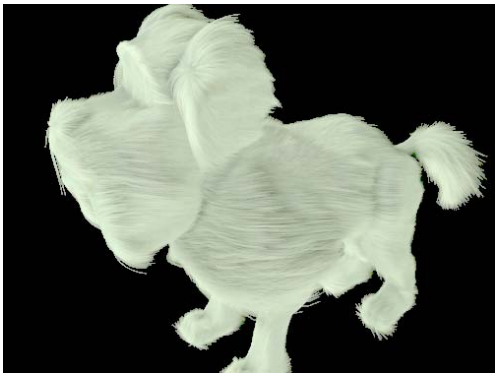
1. Open the General Parameters rollout. Set Hair Count to **329000**, Hair Passes to **3**, and Tip Thick to **1.0**.

   Note: These settings make the dog quite furry. It will take a long time to render, but the results are good.
2. Open the Frizz Parameters rollout. Set Frizz Tip to **20.0**, and Frizz X/Y/Z Freq. (all three) to **64.0**.

Render the dog:

Warning: This step takes a long time, so you might want to skip it. If you do render your version of the dog, plan on a long break.

- Activate the Perspective viewport, and then press F9 to render the scene.



The dog in all its furry glory

Styling Hair with a Spline Emitter

Some hairstyles, particularly longer ones, lend themselves more naturally to spline interpolation than surface growth. Spline-based hair basically gives you explicit control inside 3ds Max over a finite set of guide hairs. When you create hair with a spline object as the growth source, Hair creates a guide from each spline in the object. It then uses these guides as cross-sections to create hair growth. Essentially, you're creating a three-dimensional "sheet" of hair in the shape of the spline cross-sections.

For success with spline-based hair, keep these important requirements in mind:

- Hair growth is interpolated between each pair of successively numbered splines. The best way to ensure this is to create the splines that serve as the hair outline as separate objects, and then attach them all together in the correct order.
- Interpolation between pairs of splines is linear, so use as many splines necessary to create a rounded look for your hair.
- The first vertex in each spline serves as the hair root, so when you create the splines, start at the base of each hair.

In this tutorial, you'll create two different spline objects, both comprising a number of Line splines, to create a woman's hairdo. The hairdo will have bangs in the front, with a flip on the sides and long, straight hair in the back.

Set up the tutorial:

1. Open the file *spline_emitter_start.max*.

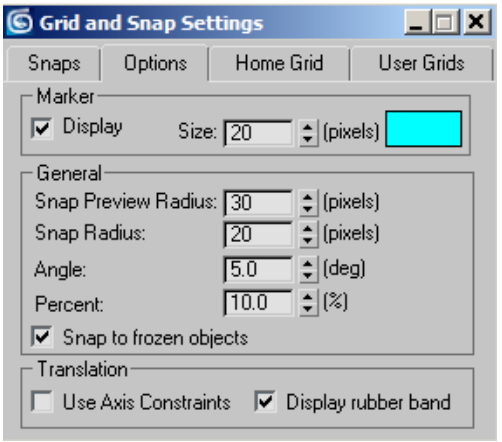
   The scene consists of a simple head mesh and three shadow-casting spot lights that are hidden at this time. Instead of using the mesh as a hair emitter, you'll create a spline-based outline for the hair.

2. Select the head in the scene and right-click it. From the quad menu that appears, choose Freeze Selection.

3.  On the main toolbar, right-click the Snaps Toggle button to open the Grid And Snap Settings dialog.

4. The only snaps option that should be on is Face. As necessary, turn off any other options and turn on Face.

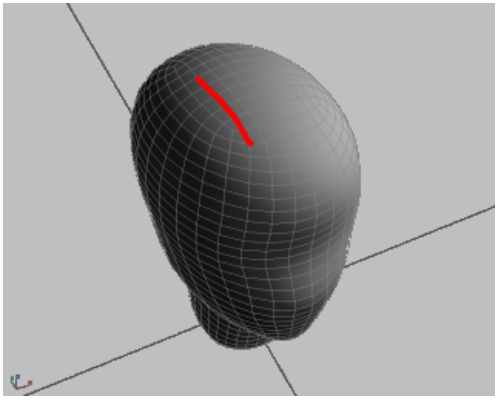
5. In the Grid And Snap Settings > Options panel, turn on Snap To Frozen Objects.



6. Click the close button in the upper-right corner to exit the dialog, and then left-click the Snaps Toggle button to turn on snapping to faces.

Create the spline cage for the hair:

In this section you'll create the splines for the hair. In that respect, you have to consider the design of the hairdo and the parting of the hair. The red line in the following illustration shows where the hair part will be. You will use it as a base line for the hair splines as they flow on either side of the head.

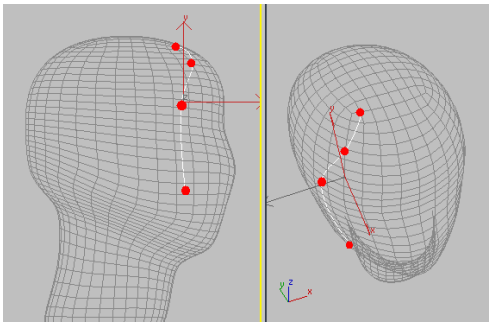


The hair part line

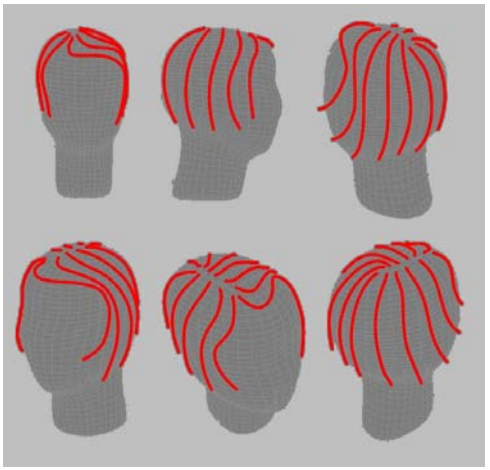
1. Go to the Create panel and choose Splines > Line. Make sure Initial Type and Drag Type are both set to Smooth.

2. In the Perspective viewport, position the mouse at the front of the parting line seen above, and then click to start the spline. Move the mouse partway down the left side of the head and click again. Move it farther down and slightly back, click again, and then move it down and closer to the front to create a nice flowing curve. Right-click to end.

   The four-vertex spline is not smooth enough to follow the contours of the head. You will make the necessary adjustments later but for now, press F3 to view the scene in wireframe mode..



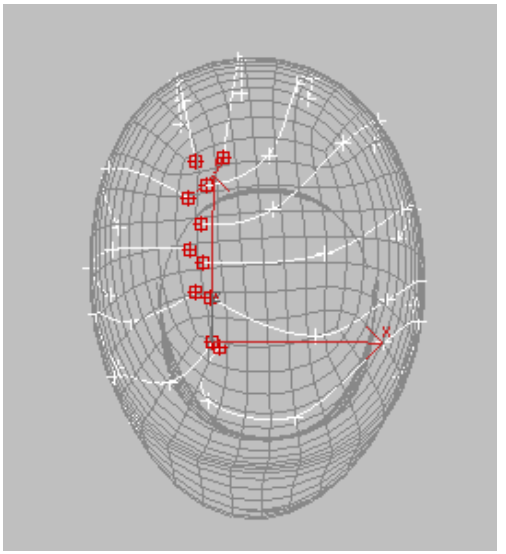
3. Continue adding splines. Start the next one a little further back from the first. Likewise for the third and fourth. Continue around the back, always placing the spline base points along the parting line of the hair. use the following image as a reference.



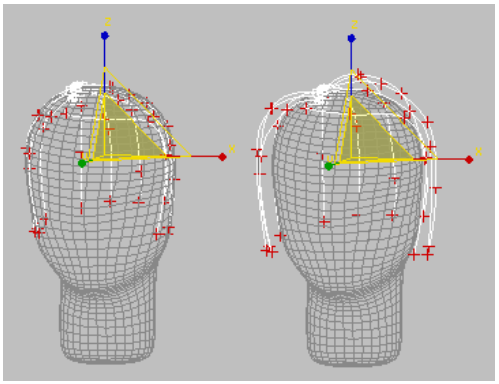
Adjust the spline cage

1. Go to the Display panel. In the Hide rollout, turn on Hide Frozen Objects. This hides the head object from the scene.

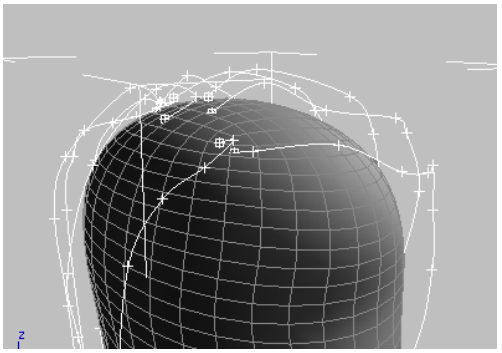
2. Select the first spline you created: *Line01,* and then go to the Modify panel.
3. From the Geometry rollout, click the Attach button.
4. Attach the splines sequentially, moving clockwise around the head. The sequential numbering of splines in the spline cage is very important for the hair modifier to work properly.
5. Go back to the Display panel and turn off Hide Frozen Objects.
6. With the spline cage selected, go to the Modify panel and rename the object **Hair**.
7. Go to the Vertex sub-object level. Looking at the top of the head, select all the first vertices representing the hair roots.



8. Press Ctrl+I to invert the selection.
9. From the main toolbar, choose the Scale tool and set the scale pivot to Use Selection Center
10. Scale the selection up so that the splines flow more naturally around the head.

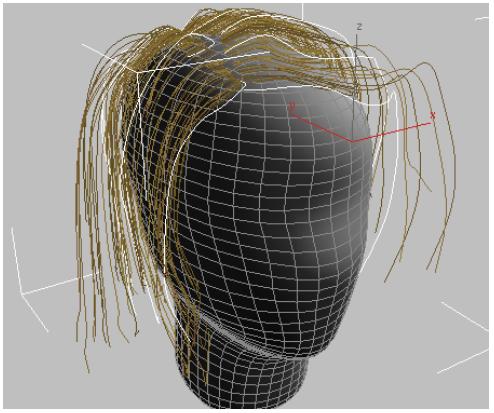


11. Adjust the individual vertices so they fit the shape of the head nicely, floating just above the mesh. Make the necessary adjustments to follow the design of the hairdo you have set yourself to achieve. If necessary, refine the splines to add vertex control to shape the spline cage with more detail.



Generate the hair:

1. Continue working on your file or open the file *spline_emitter_hair.max*
2. With the *Hair* object selected, apply a Hair And Fur (WSM) modifier.



Hair And Fur modifier applied to splines

Adjust the hair settings:

The settings described in the following steps were arrived at through experimentation. You might find other settings that work better for your hair, so feel free to experiment yourself, and revise the suggested values.

1. Open the General Parameters rollout and set these values:
   - Hair Count =**1200**
   - Hair Segments =**25**
   - Hair Passes =**4**
   - Root Thick =**6.0**
   - Tip Thick =**4.0**

   These settings control the number of hairs, their curvature, and their size.
2. Open the Material Parameters rollout and set these values:
   - Occluded Amb. =**0.0**
   - Tip Color = dark brown**RGB (34,28,13)**
   - Tip Color = dark brown**RGB (29,24,11)**
   - Hue Variation =**15**

   These settings control the material properties of the hair, such as color and shininess.

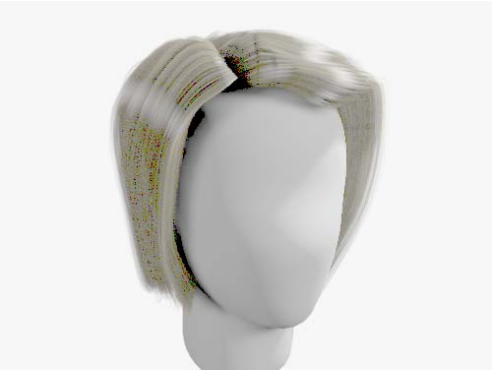
3. Open the Frizz Parameters rollout and set this value:
   - Frizz Root =**80**

   This setting adds a certain amount of noise to the root of the hair, making it look denser and more natural.
4. Open the Multi Strand Parameters rollout and set these values:
   - Count =**5**
   - Root Splay =**0.85**
   - Randomize =**15**

   These parameters add a certain amount of clumping to the rendered hair.

Render the hair:

- Render the hair in the Perspective viewport.



The final result

If you have time, try rendering the hair from various angles.

The same hair, rendered in a partial profile

The same hair, rendered nearly from the back

To see our final results, open the scene *spline_emitter_final.max*. Your results might differ significantly; there are many variables in projects like this.

Also if you have time, try adjusting spline vertices to further style the hair. Notice that as you adjust the splines, the display hairs in the viewports are updated interactively.

Working with Hair Presets

Presets let you save or load the various hair settings.

Set up the scene:

- Continue working on your file or open the file *spline_emitter_final.max.*

Save your work:

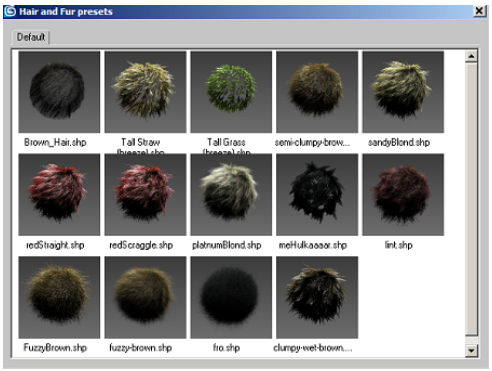
Now that you have adjusted the hair parameters, you will save a hair preset for later recall.

1.  With the *Hair* object selected, go to the Modify panel and expand the Tools rollout.
2. In the Presets group, click the Save button.
3. In the dialog that appears, name the preset **Brown_Hair** and then click OK.

Load a new preset:

1. In the Tools rollout > Presets group, click the Load button.

   The Hair And Fur Presets dialog appears. The preset you just saved is displayed in a thumbnail called *Brown_Hair.shp*.



2. Double-click the *platnumBlond.shp* thumbnail to load that Preset.
3. Render the Perspective view to see the results. The character now has light blond hair, but the parameters need adjustment.

Platinum blond hair: default preset settings

Presets are a good way to load hair settings, but often you need to adjust the preset parameters to get the effect you are aiming for. In this case, it looks like the hair ought to be finer and straighter than the default settings show.

Adjust the preset settings:

1. Change the hair settings as follows:
   - General Parameters > Hair Segments =**30**
   - General Parameters > Root Thick =**4.0**
   - General Parameters > Tip Thick =**3.0**
   - Frizz Parameters > Frizz Root =**50**
   - Frizz Parameters > Frizz Tip =**0**
   - Multi Strand Parameters > Multi Strand Count =**4**
   - Multi Strand Parameters > Root Splay =**0.2**
2. To test the results, render the Perspective view again.

Blond hair after adjusting the preset settings

Feel free to experiment with other settings.

Working with Instance Objects

Organic growths such as feathers, leaves, flowers, and scales have properties similar to hair, and present similar challenges for modeling. The Hair And Fur modifier lets you model these objects by growing *instances* of an object.

When you work with instances, please keep the following points in mind:

- You're creating geometry, even if it is only at render time, so memory is a limitation on hair count. For this reason, use an object with a low polygon count, and a comparitively low Hair Count.
- The material applied to your growth is inherited from the growth object, not the instance itself; only UVs come from the instance.
- The root of the instance, where the 3ds Max pivot is, will be at the root of where the hair would otherwise be.
- The shape or grown instances, including their size, bend, and so on, result directly from the hair settings, including styling.
- Despite the expression "instance," objects created with Hair's Instance Node tool are not true 3ds Max instances of the original object: they do not automatically reflect subsequent changes to the original. To updated instanced hairs, you must click the button in the Instance Node group after you edit the source object.

Set up the tutorial:

1. 1. Open the file *instancing_start.max*.

   The scene consists of a dog model with Hair applied, and a plane mapped with a leaf image.

   Both the dog model and the leaf have already been textured with the same material.

2. Render the Perspective view.

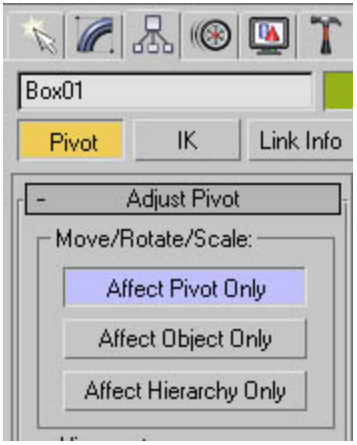
Dog and leaf both share the same material

Check the leaf object's pivot point:

- Select the *leaf* object.

  Check that the leaf object's pivot is at its base, where it will connect with the dog's skin.

  If the pivot weren't at the leaf's base, you'd need to go to the Hierarchy panel > Adjust Pivot rollout, turn on Affect Pivot Only, and then move the pivot to the proper location.

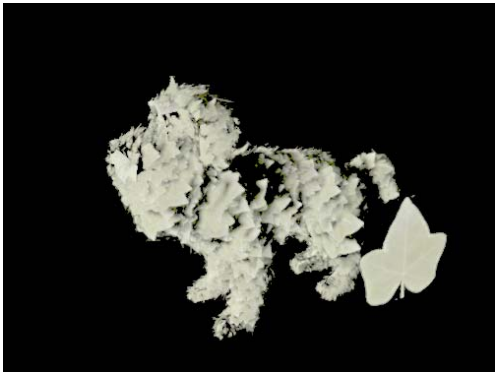


Choose the leaf to use as an instanced hair:

1. Select the dog object and open the Tools rollout.
2. In the Instance Node group, click the pick button (if there is no instance, its label shows "None"), and then in a viewport, click the *leaf* object.

Render the result:

- Render the Perspective view once more.



Leaf applied as an instanced hair

Working with Surface Lock

One of the useful tools Hair offers is the ability to lock hairs to a surface. This feature allows you to create features such as a braid as easily as you can model one. In this tutorial you'll use the surface lock feature to create a twist of hair.

Set up the tutorial:

1. Open *morph_braid_start.max*.

   This scene contains three cylinders combined into a single object named *Braid surface*, which morphs into a braid. This braid geometry is not renderable: its only purpose is to deform the hair.

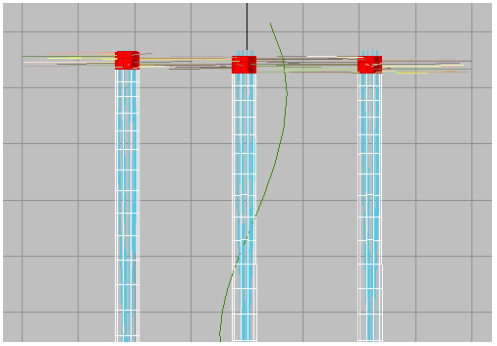
2. Select *Braid surface* and note the hair settings.

   When locking hair to a surface, you are actually locking the guides to the surface, so it's a good idea to use low values for the parameters that spread hair away from the guides; for example, Random Scale and Frizz. For realistic hair, set these values a little higher than 0. It is also a good idea to use a higher-than-usual Hair Segments value, in order to improve deformation.

Set the sub-objects that grow hair:

You'll grow hair from the tops of the cylinders and then drape it down around the surface.

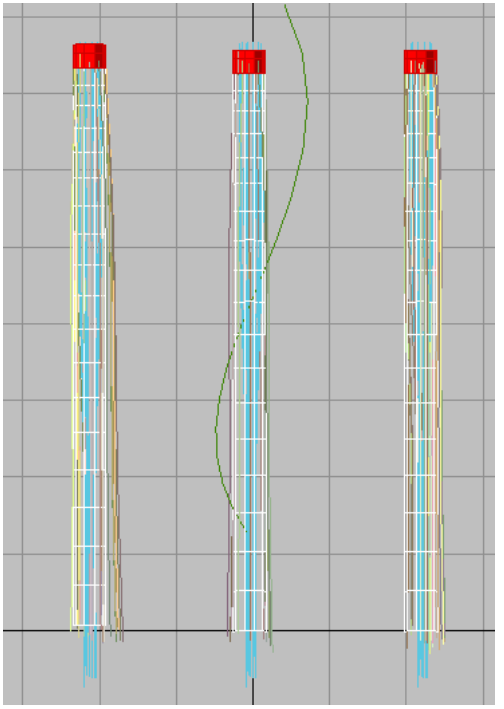
- At the Polygon sub-object level of the Hair And Fur modifier, select the top polygons of each cylinder as shown, and then click Update Selection.



Top two segments of the hair braid selected

Align the hair to the braid model:

- On the Tools rollout, click Recomb From Splines and then pick the *Spline Guides* object.



The hair aligns to the direction and length of these splines.

You could easily create these splines from edges of the geometry, drawing them by hand. Or you could just create the same hairstyle using the styling tools and skip the splines altogether.

The next step is to lock the hair to the surface of the cylinders, which you do in the Styling rollout.

Lock the hair guides:

1.  Change from the Polygon to the Guides sub-object level.

   This also activates the controls on the Styling rollout.

2. Open the Styling rollout.

   By default, all the guide vertices are selected, so you don't need to select any.

3.  Click the Lock button to turn it on. Now the hair guide vertices are locked to the *Braid surface* object.

   Note: In other situations, it might be desirable to lock only specific parts of the hair to a surface; for example, to wrap hair around curlers, or tuck hairlocks behind the ears.

4. Click Finish Styling to turn this button off. This also exits the Guides sub-object level.

Set up rendering and render the result:

1. In the modifier stack, turn on the Morpher and Path Deform modifiers.

   Note: For animation, the braid mesh can be skinned to a bone chain, instead of posed with Path Deform.

2. Go to frame 20.

3. Render the Camera01 viewport.

The completed braid

Rendering of braid with layered hair

If you have time, you can also look at the scene *morph_braid_finished.max*. This scene contains two additional Hair And Fur modifiers, which model layered growth effects.

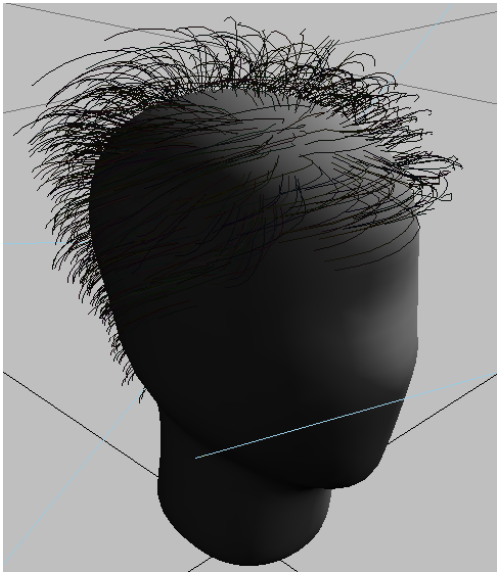
Copying Hair: Transplants, Wigs, and Toupees

Once you've created mesh-grown hair, you can use a number of ways to move it from one character or creature to another. This lesson demonstrates three of them.

Method 1: The Toupee

The "toupee" method is relatively simple. Starting with mesh-grown hair you get rid of unnecessary geometry in order to move this hair elsewhere.

1. Open the file *toupee_start.max*.



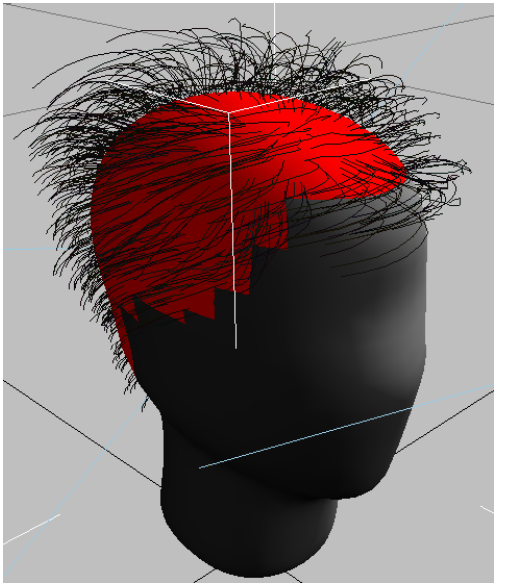
2. Select the head mesh, and then go to the Modify panel. On the Tools rollout, in the Hairdo group, click Copy.

   This caches the full hair description, including guides and materials.

   Important: If you skip this step, the method will not work!

3. Go to the Polygon level of the Hair And Fur modifier.

   The polygons selected to grow hair become visible.



The selection of polygons that grow hair

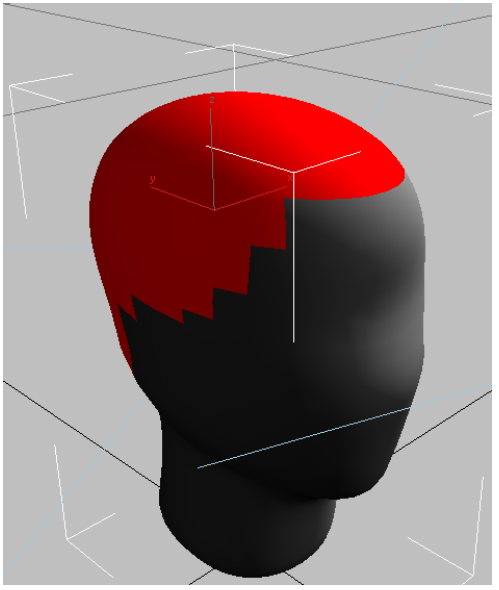
4. On the Selection rollout, in the Named Selection Set group, click Copy.

   The Copy Named Selection dialog appears.

5. In the dialog, click to highlight the *tophead* selection set, and then click OK.

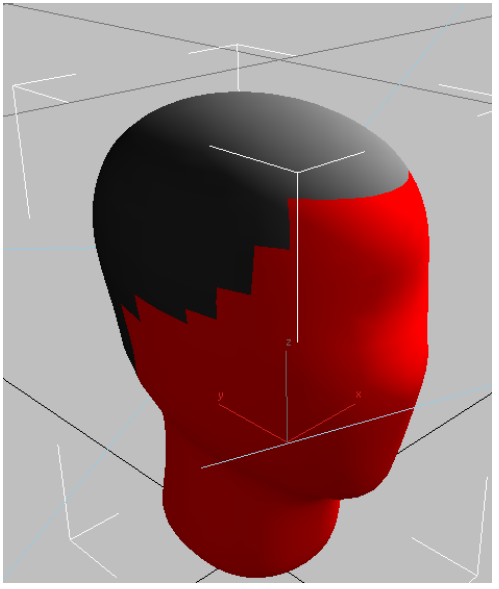
6. On the modifier stack, expand the Editable Mesh entry. Click Yes to dismiss the warning that appears. Click the Polygon entry to go to that sub-object level.

7. On the Selection rollout, under Named Selections, click Paste.



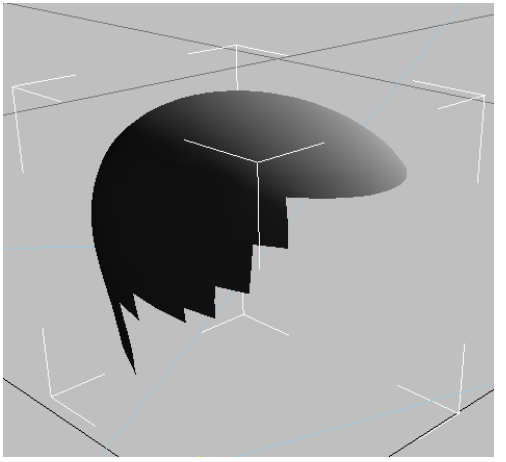
The hair polygon selection pasted to the editable mesh

8. Choose Edit > Select Invert to invert the selection.



The polygon selection inverted

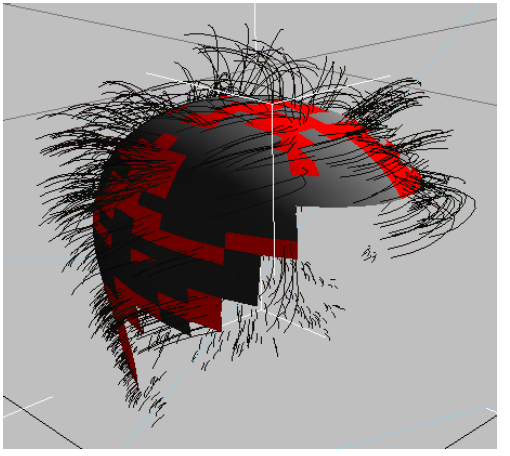
9. Press Delete to delete the polygons that don't grow hair.



After Delete, only the hair-growing polygons remain.

10. On the modifier stack, highlight the Polygon level of the Hair And Fur modifier once again.

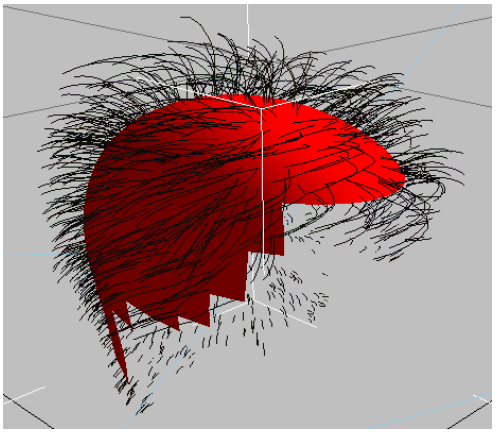
    Your selection has probably been scrambled a bit.



After you edit the mesh, the poly selection in the Hair modifier is scrambled

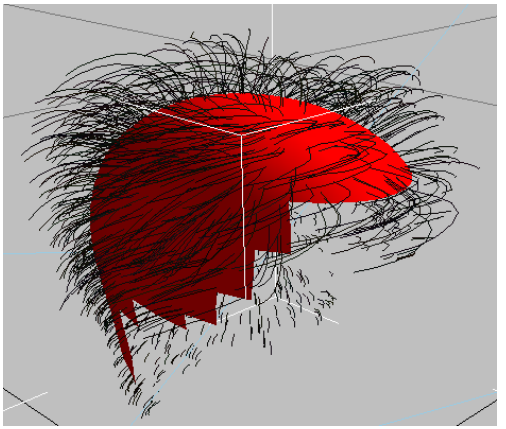
11. Press Ctrl+A to select all the polygons. Then on the Selection rollout, click Update Selection.

The hair now looks approximately like it did originally, but not exactly.



Updating the full polygon selection

12. On the Tools rollout, in the Hairdo group, click Paste.



Pasting the original hairdo to complete the toupee

You now have a hair toupee that you can plant under the skin of your characters. For best results, make the surface polygons non-renderable (Edit > Object Properties > General Panel > Rendering Control group > Turn off Renderable).

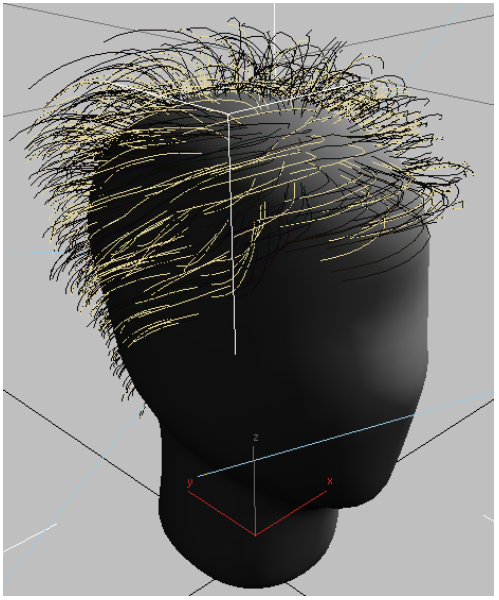
Using "toupees," you can create a library of custom hair setups, retaining only the essential geometry: that is, only those polygons from which the hair grows.

Method 2: The Wig

For the "wig" method, you first convert the hairs to an editable spline object, then use the spline object to grow new hair.

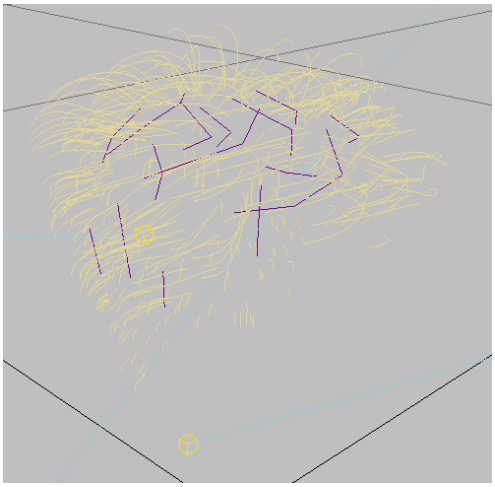
1. Open the file *wig_start.max*.
2. Select the head object (*objpCube1)* and go to the Modify panel.
3. On the General Parameters rollout, reduce the Hair Count to **2200**.

   The initial value of 22,000 is a huge processing load.
4. On the Tools rollout, in the Convert group, click Hair -> Splines.



Hairs converted to splines

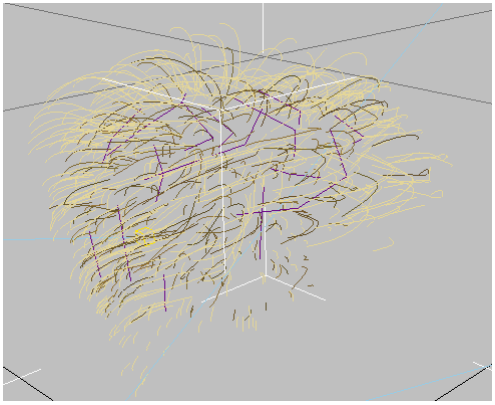
5. Press **Delete** to delete the original mesh object.



Hair splines after deleting the mesh

6. Select the resulting spline object and then apply a Hair And Fur modifier.

   This creates a spline growth.



New hair grown from the splines

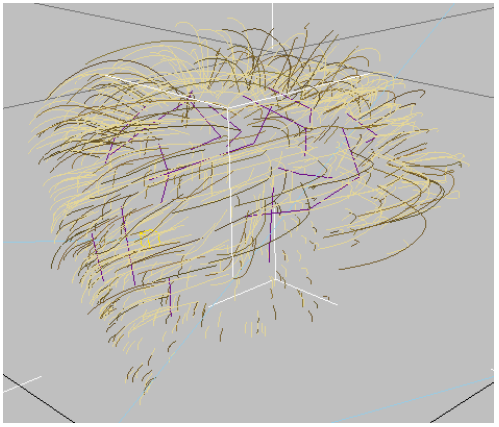
   Because it's a spline growth, not a mesh growth, the interpolation is uneven. To resolve this, you'll disable interpolation.

7. On the General Parameters rollout, turn off Interpolate.

   This means that Hair won't fill in between the guides. In other words, you'll have one hair per spline, if the Hair Count is set high enough.

8. Turn off displacements by setting values Rand. Scale, Frizz Root and Tip, and Kink Root and Tip to **0.0**.

   The original values are already reflected in the spline object you created.



With Interpolation and displacements turned off, the new hair follows the splines.

9. On the Multi Strand Parameters rollout, set count to **20**, and also set Root Splay and Tip Splay to **0.5**.

10. Render the Perspective view.

The rendered wig

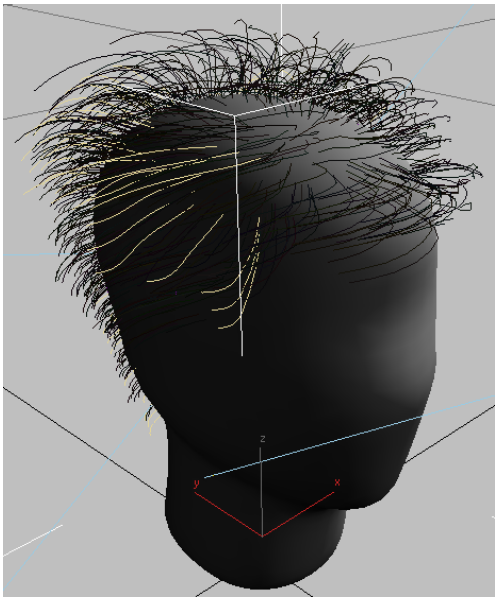
You now have a hair description that is independent of any mesh, upon which you can run dynamics if you like.

Method 3: The Transplant

The "transplant" method essentially consists of copying the hairdo, selecting a target surface that's positioned as closely as possible to the original, adding a Hair And Fur modifier to the new surface, and then pasting the hairdo.

The steps that follow also show what goes on inside Hair when you copy and paste hairdos.

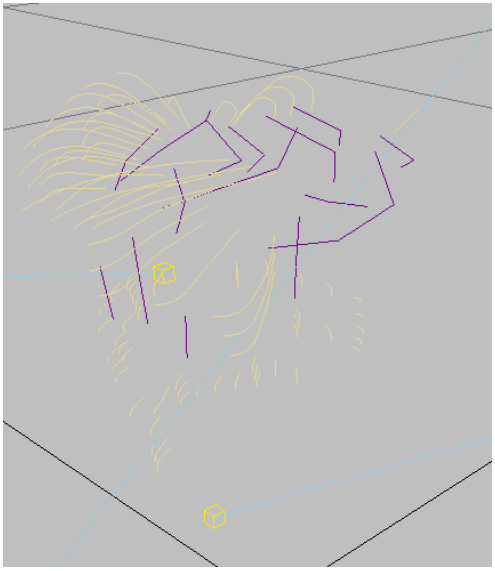
1. Open the file *transplant_start.max*.
2. On the Tools rollout, click Convert > Guides->Splines.



Hair guides (not all hairs) converted to splines

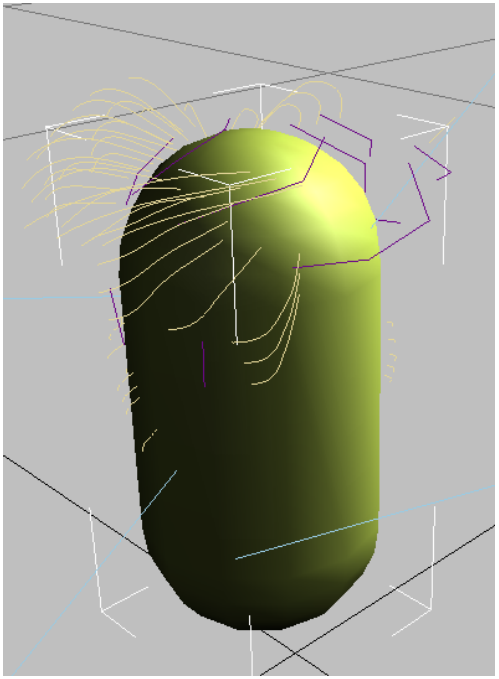
This differs from the wig method (described above) in that this time, we use the hair guides instead of the individual hairs.

3. Save the hair settings by clicking Tools rollout > Presets > Save. Name the preset **temp_hair_material**.
4. The head is no longer necessary, so delete it.

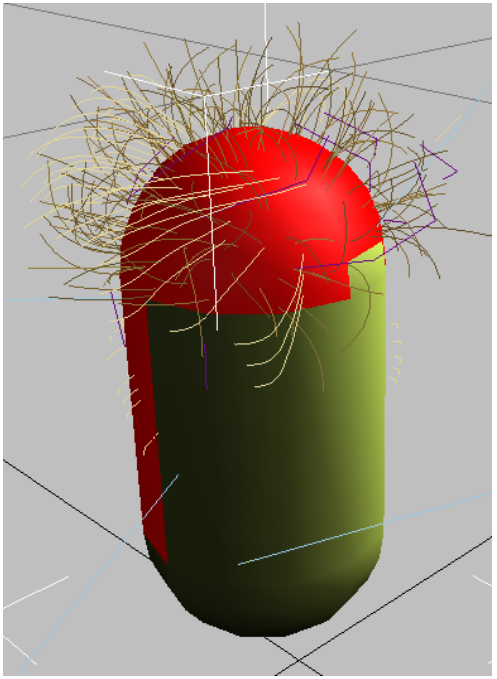


Hair-guide splines with the mesh deleted

5. Position the spline object created in step 1 around a new growth mesh. This illustration uses a Capsule primitive, but feel free to use any type of object you like.



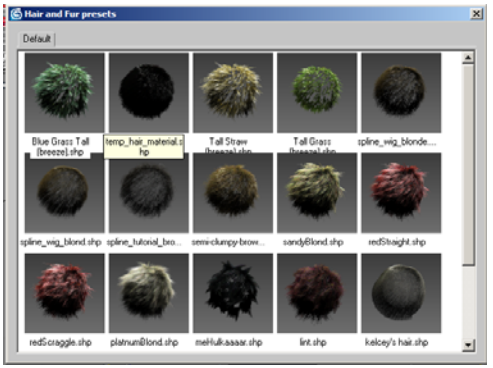
Hair-guide splines positioned on a new surface



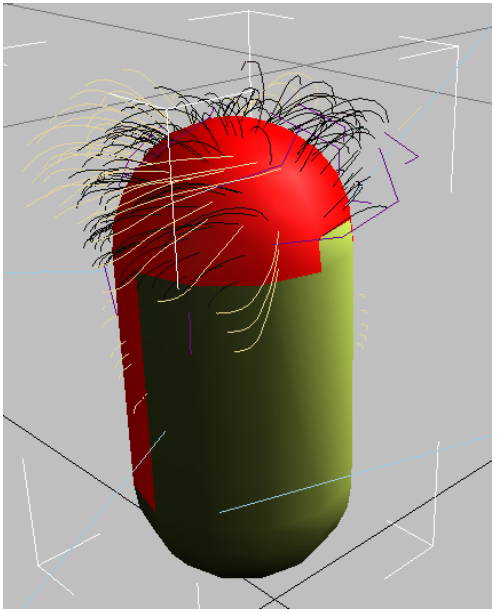
Hair regrown from a new polygon selection

6. Apply a Hair And Fur modifier to the new surface, select the polygons from which the hair should grow, and then click Update Selection.

7. Recover the original hair settings. On the Tools rollout, in the Presets group, click Load. and then in the presets dialog, double-click the *temp_hair_material* thumbnail.



8. On the Tools rollout, click Recomb From Splines, then in a viewport, click the spline object that was converted from the hair guides.



The recombed hair

Note: Technically, you don't need the spline object after this step, but you might want to keep it around for a future hairdo.

9. Render the Perspective view.

The rendered transplant

Cloth

Cloth Tutorials

Laura by Georges Walser

The tutorials included in this section walk you through a variety of methods for using Cloth.

Features Covered in This Tutorial

- Using the Garment Maker
- Applying the Cloth modifier
- Locking points on the cloth
- Adding space warps and collision objects to the cloth
- Running a Cloth simulation
- Adjusting fabric properties

Tutorial Files

All the files necessary for this tutorial are provided on the program disc in the *|tutorials|cloth* directory. Before starting the tutorials, copy the *|tutorials* folder from the disc to your local program installation.

In This Tutorial

For best results, follow the tutorials in this order:

Creating a Billowing Flag

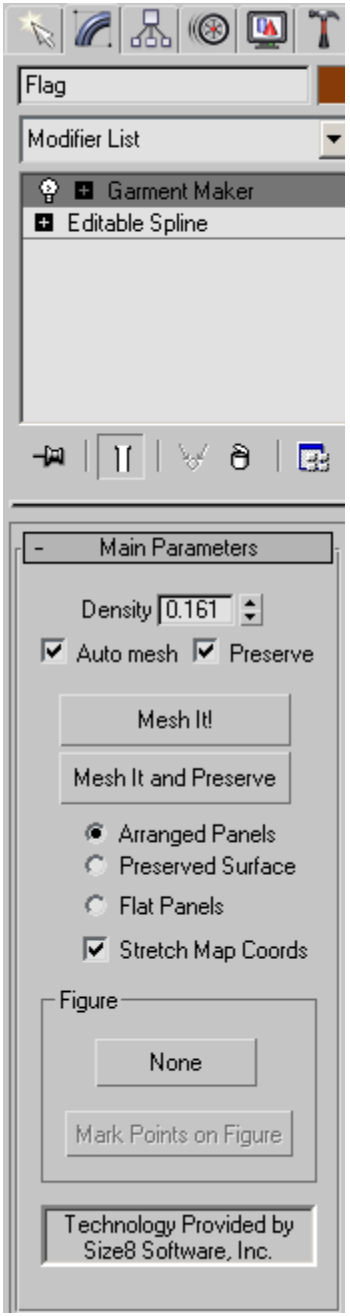
This quick-start tutorial will introduce you to some of the basic concepts you'll need when using Cloth. It is meant simply to provide an overview to the Cloth modifier. Do not be concerned if you don't understand the entire process, as the "why" will be explained further in the later tutorials.

Create a cloth flag from a spline object:

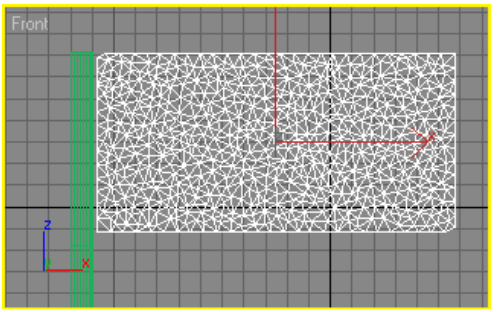
1. Load *quickstart.max* from your *\tutorials\cloth* folder.

   This scene contains a rectangular spline object named Flag and a cylinder named FlagPole.

2. Select the rectangle shape named Flag and apply the Garment Maker modifier to it.



Modifier stack with Garment Maker modifier applied to the Editable Spline object Flag



The resulting Flag object is now a 3D mesh.

This turns the 2D spline into a 3D mesh that you can use as cloth.

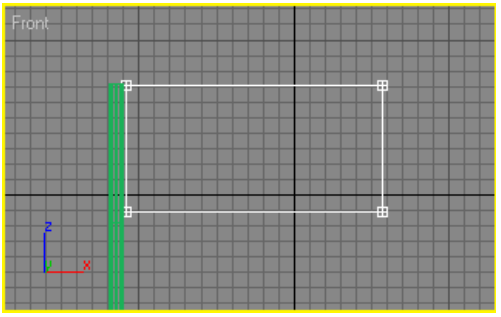
The corners of the new mesh get "rounded" because the flag spline was not set up correctly.

3. Delete the Garment Maker modifier.

   The spline object reverts to its original status.

4. Access the Vertex sub-object level and then select all four vertices of the spline (press Ctrl+A).

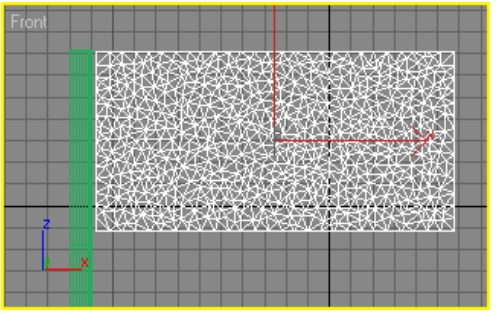
5. On the Geometry rollout, click Break.



Flag with vertices broken

This causes the segments within the spline to become independent, as shown above. This preserves the corners when you apply Garment Maker. Whenever you have a spline that changes appearance after the application of Garment Maker, check the vertices and break the ones that cause this kind of issue.

6. Exit the sub-object level and then reapply the Garment Maker modifier.

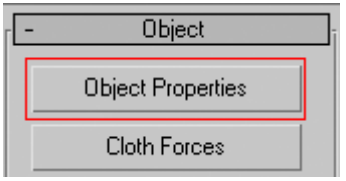


Flag with Garment Maker applied

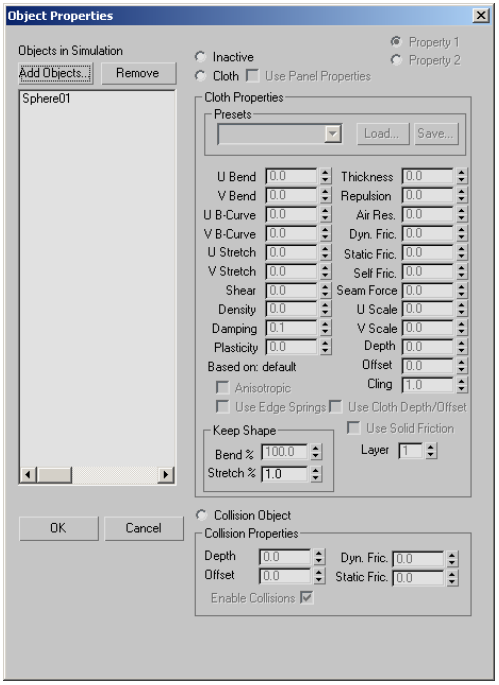
Apply and set up the Cloth modifier:

1. With the Flag object still selected, apply the Cloth modifier to it.

2. On the Object rollout, click the Object Properties button.



This opens the Object Properties dialog.



First, you'll tell Cloth which objects should be part of the cloth simulation. Currently only Flag is present in the left-hand column of the Object Properties dialog; the FlagPole object should be part of the simulation as well.

3. On the Object Properties dialog click the Add Objects button, select FlagPole, and then click OK.

   This adds the FlagPole object to the simulation.

   Next you'll set which Objects are to act as cloth and which objects the cloth will interact or collide with.

4. In the list on the left side of the Object Properties dialog, click Flag, and then click the Cloth radio button.

   This tells the simulation that Flag is to be a cloth object.

5. In the list on the left side of the Object Properties dialog, click FlagPole, and then click the Collision Object radio button.

   This tells the simulation that FlagPole is a collision object with which the cloth object can interact.

6. Click OK to close the Object Properties dialog.

Run the simulation:

Before you simulate, it's a good idea to check the cloth scale to make sure you get the results you might expect. To do this, you'll measure the flag as it relates to the cloth simulation. Cloth works in real-world units to create its simulation, so it's important to make it a habit to check the size of your objects.

1. Go to the Create panel and click the Helpers button.

2. Click Tape, and then in the Front viewport drag out a Tape helper to determine the width of the flag.

   You'll find that it is approximately 165 3ds Max units in width. Currently, Cloth is set (in the Simulations Parameters rollout) to 2.54 cm/unit, which equals 1 inch per unit (2.54 cm=1 inch). So at 165 inches wide, the flag is 13.75 feet wide, which is a big flag. That's not unrealistically large, but it is big, which is something to keep in mind because it affects the cloth behavior.

3. On the Cloth Object rollout, click Simulate. Let the simulation calculate for a few frames. After about 35 frames, press the Esc key to stop the simulation.

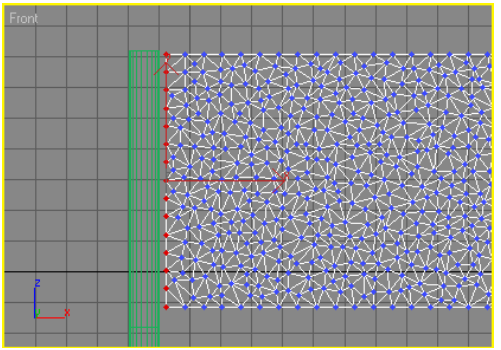
   The flag falls to the ground because it is not attached to the flagpole in any way. To attach the flag to the flagpole, you will need to access the Cloth Group sub-object level and create a group of vertices to attach to the flagpole.

Attach the flag to the pole:

1. Go to the Group sub-object level of the Cloth modifier.

   The flag vertices become visible.

2. In the Front viewport, select the column of vertices on the Flag object nearest the flagpole, as shown below.



Vertex selection for FlagPole binding

3. On the Group rollout click the Make Group button, and then name the group **FlagPoleSelection**. Click OK to close the dialog.

   Now that you've made and named a group, you need to assign it to the flagpole.

4. On the Group rollout click the SimNode button, and then pick FlagPole by either selecting it in the viewport or by pressing the H key and using the Select Objects dialog.

   Alternatively you could attach the flag to the flagpole using the Surface constraint, but that method locks each vertex to the triangle on the chosen object whose *center* is closest to the vertex. In the case of the flagpole, some of the vertices would be pulled toward the cylinder cap triangles to which they are closest, which might create unexpected results.

5. Exit the Group sub-object level.

Run and refine the simulation:

1. On the Object rollout click Simulate.

   The flag drapes down and is held up by the flagpole, but it doesn't seem to drape very naturally. This is due to the size of the cloth. Remember that you determined that the flag is almost 14 feet wide, so you now need to edit the cloth properties for the flag so that it behaves more realistically.

2. Click the Object Properties button, and then in the left-hand column of the floating dialog click Flag.

3. Change the Shear value to **350.0**.

4. Change the U Bend value to **50.0**.

   Altering these two parameters forces the cloth to be less flexible, cause more realistic folds in the cloth drapes.

5. Close the Object Properties dialog, and then click Erase Simulation to remove the existing simulation data.

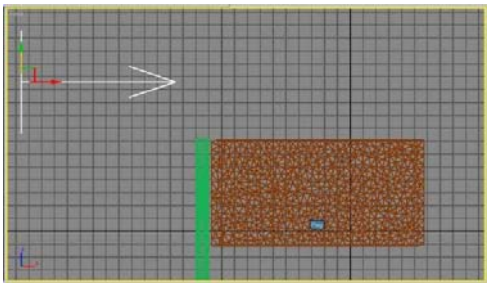
6. Click Simulate again to see the flag drape.

Add a wind force:

To make the simulation more realistic, you'll use a Wind space warp to make the flag flap in the breeze.

1. Go to Create panel > Space Warps > Forces and then add a Wind space warp In the Left viewport.

2. Rotate the space warp to point in the same direction as the flag, as shown below.



Wind space warp placement in the scene

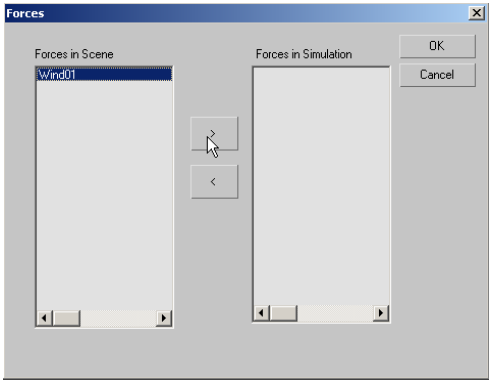
3. With the Wind space warp selected, go to the Modify panel and change the Strength value to **10.0**.

   Next you'll tell the Cloth simulation to take the wind into account by adding it as a force.

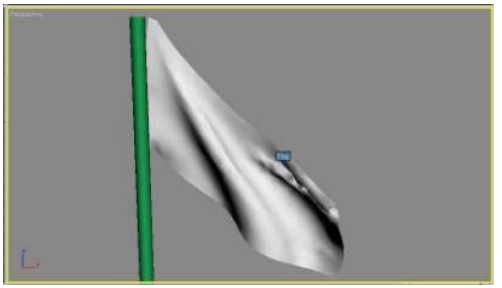
4. Select the Flag object and then on the Object rollout click the Cloth Forces button.

   This opens the Forces dialog.

5. In the Forces In Scene column, click Wind01 and then click the right-arrow button in the center to move it over to the Forces in Simulation column. Click OK to exit the dialog.



6. Erase the simulation again and then click Simulate and let the new simulation run to completion.



Flag blowing after simulation is complete

You can see how easy it is to create a simple cloth object with Cloth. Now that you've had a taste of how the system works, you'll use the major Cloth features to build a realistic shirt for a character model.

Next

Designing a Shirt (page 765)

Designing a Shirt

In this tutorial, you will go through the process of building a shirt for a character from scratch.

The first lesson will lead you through several key features of the Garment Maker modifier that let you design the patterns that will be used to create the garments.

The concepts covered in this lesson are as follows:

- Drawing splines for the pattern
- Applying Garment Maker to the pattern
- Working with MultiSegment splines
- Positioning the Garment Maker panels over the character
- Creating seams

Create the shirt pattern:

1. Load *tutorial_1.max* from your *\tutorials\cloth* folder.

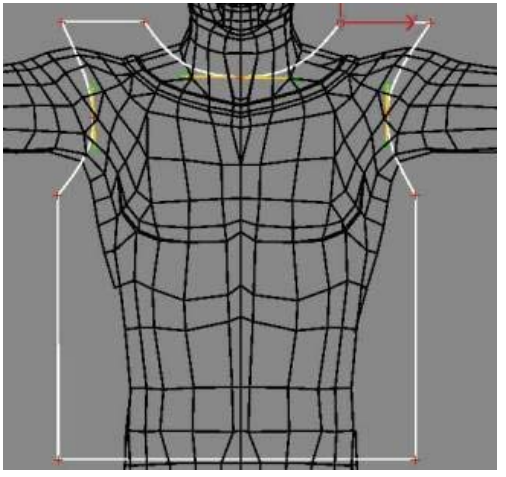
This scene contains a character for which you will make a shirt.

2. Select the character named Jester. In the Front viewport, rotate it -90 degrees on the X axis.

   The Jester character model should now be facing upward in the Top viewport. Garment Maker requires that you create patterns in the Top viewport. Rotating the character will allow you to use it temporarily for fitting while creating the pattern. When you've finished creating the patterns, you will rotate it back.

   Next you'll start to make a pattern for a shirt. First you'll create the panels that will make up the front and back of the shirt.

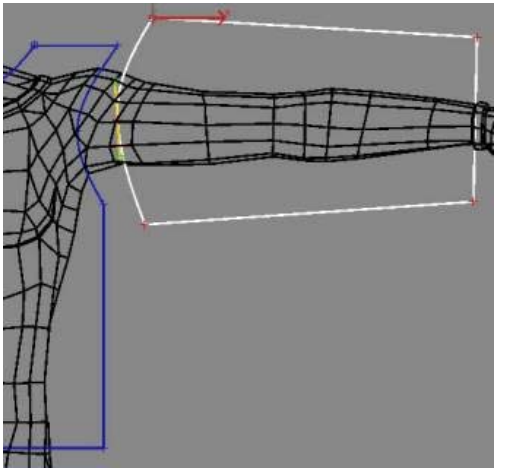
3. On the Create panel click Shapes > Line, and create a spline in the Top viewport that resembles the front of a shirt without sleeves. This will look something like a vest, as shown below.



Front of shirt in the Top viewport

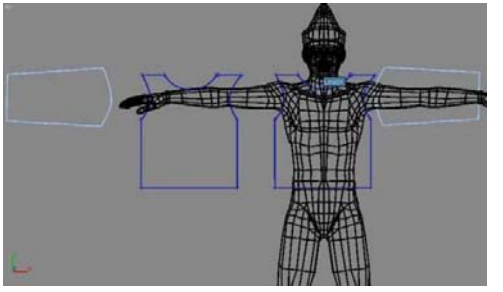
Next you'll make the sleeve for the shirt. The sleeve is basically one long piece of fabric that wraps around the arm, with a seam at the bottom. The end of the sleeve that will attach to the shirt should be curved to better fit the shoulder area.

4. In the Top viewport, create a spline sleeve that fits the arm's length, and is about three to four times the arm's width.



Sleeve in the Top viewport

5. Copy the sleeve and front panel splines of the shirt so that you have a front and back plus two sleeves. Also, rotate the sleeve on the left so that it is properly oriented, as shown below.



Pattern panels copied and arranged

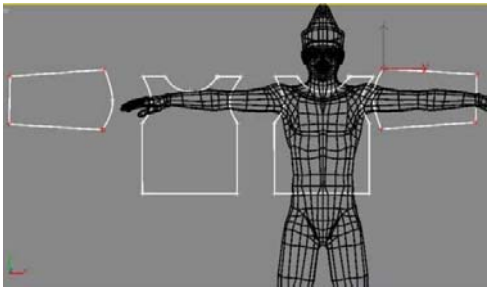
Next you'll combine all the pieces and set them up to be sewn together.

6. Use the Attach function to combine all the editable splines into one object and name it **Pattern**.

   In order for Garment Maker to work, all of the panels that are created as part of a single piece of clothing must be part of the same object.

That's why you attached all the splines. Next you'll break off different segments of the pattern so that these edges can be sewn together.

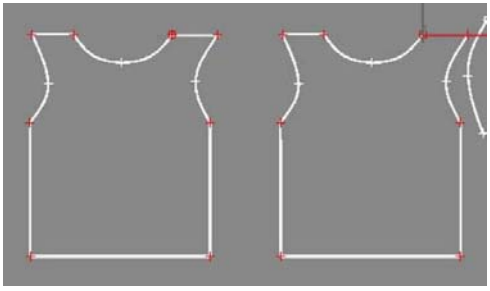
7. At the Vertex sub-object level, select all four corner vertices of both sleeves and then click Break.



Vertices selected for breaking

This will give you four separate splines to select and sew together instead of having only one spline. When you work with Garment Maker, you need to make sure that your shape contains separated splines to use as the seam edges.

8. Select the eight corner vertices on both the front and back pieces of the shirt, and click Break again.



Vertices selected for breaking

Now that the pattern is ready, you'll apply the Garment Maker modifier to make this 2D spline pattern into a 3D mesh.

9. With the Pattern spline selected, go to the Modify panel and apply the Garment Maker modifier.

When you apply Garment Maker to the closed splines it fills them in with an irregular triangular mesh that is designed for cloth deformation.

Fit the shirt to the character model:

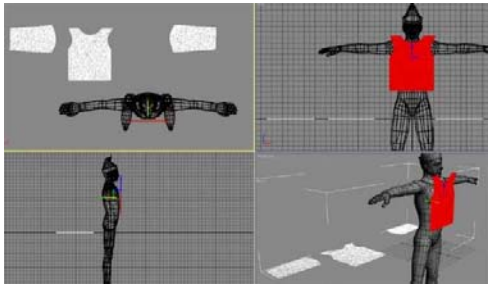
Now that you're done with the preliminary creation and sizing for the pattern, you'll rotate the Jester back into standing position.

1. In the Front viewport select the Jester object and rotate it 90 degrees around the X axis.

   The next step is to position the panels of the pattern around the character.

2. Go to the Panels sub-object level of the Garment Maker modifier and select the panel that makes up the front of the shirt.

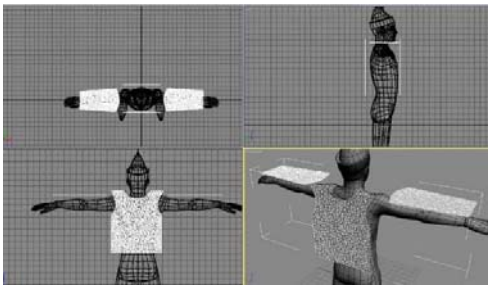
3. Move the panel into place in all four viewports so it lines up well with the front of the character. This panel will need to be rotated 90 degrees around X and moved up and forward a bit to line up with the character as shown below.



Positioning of the front shirt panel

4. Still at the Panels sub-object level, select the panel that makes up the back of the shirt. Move and rotate this panel into place. This panel will need to be rotated 90 degrees around X as well as 180 degrees around the Z axis so the mesh is facing outward.

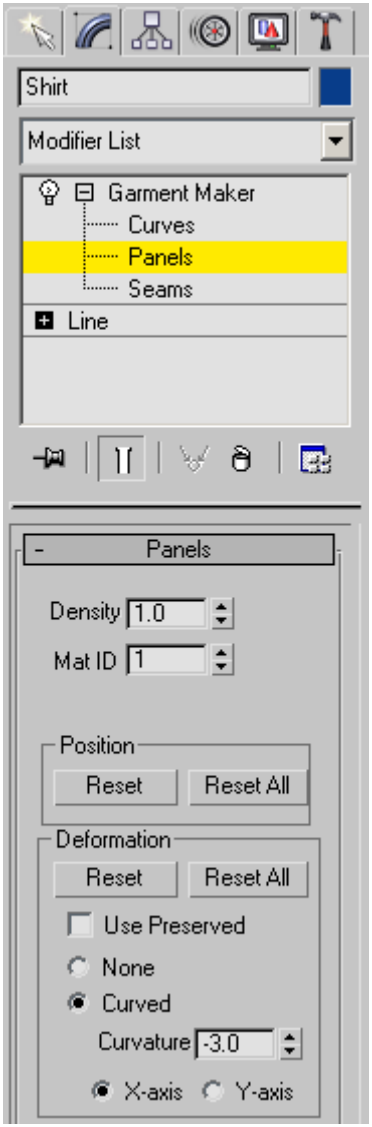
5. Move the sleeve panels into place above the arms.



Positioning of the back and arm shirt panels

You'll adjust a few parameters of the panels before adding the seams to the shirt's panels.

6. At the Panels sub-object level select one of the sleeve panels. In the Panels rollout's Deformation group choose the Curved radio button option. Set the Curvature value to **-3.0** and choose the Y-axis option.



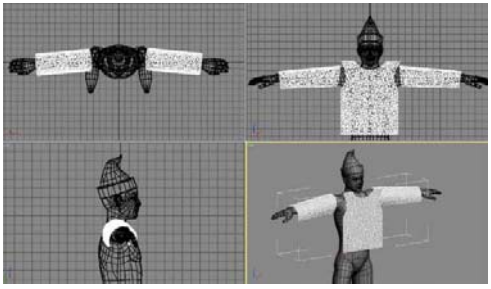
This causes the sleeve panel to bend around the arm.

7. Using the Move and Rotate tools, reposition the panel to fit more closely around the arm.

   If the sleeves are not wide enough to curve around the arm, go back to the Editable Spline level on the stack to make them a bit wider. To

get Garment Maker to recognize this change, tweak the Density spinner up and down in the Garment Maker > Object rollout after editing the splines.

8. Repeat these steps to curve the other sleeve and position it to resemble the following illustration.



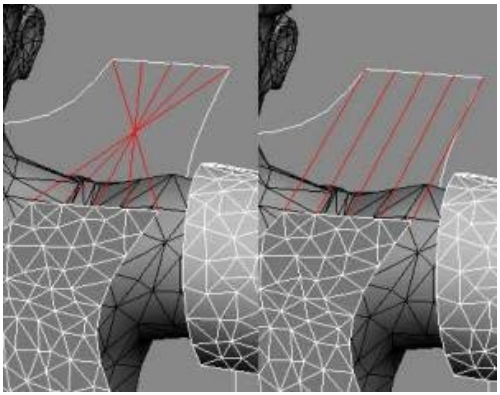
Sleeve panels with curvature

Make the shirt seams:

All the panels are in place, so next you'll make some seams for sewing them together. You can make seams at both the Curves and Seams sub-object levels. The Curves level is a good place to make seams quickly if you know exactly how they need to connect. However, this method can be a bit confusing at first. Therefore, you'll use the Seams level because it gives more visual feedback.

1. Go to the Seams sub-object level of the Garment Maker modifier. Select the edge on the front panel of the shirt above the left shoulder. It turns red to indicate it is selected.
2. Press and hold the Ctrl key, and then select the corresponding edge on the back panel of the shirt. On the Seams rollout click Create Seam.

   If a dialog box comes up that reads, "Seamed segments not within tolerance," increase the value for the Seam tolerance on the Seams rollout. You might also get a twisted seam. If this happens, click Reverse Seam on the Seams rollout.

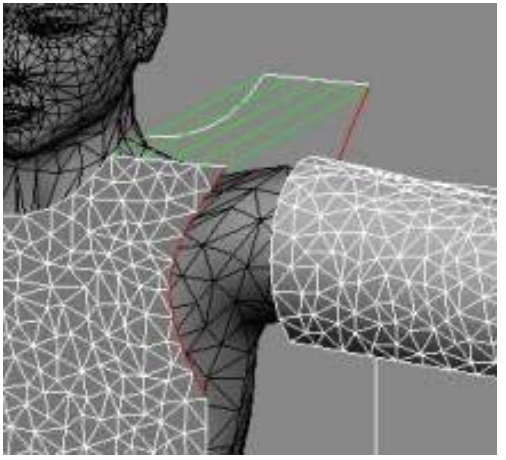


Left: Twisted seam
Right: Correctly aligned seam

Most of the seams for clothing can be made as easily as this: Select two edges and then click Make Seam.

The exception to this is creating the seam between the sleeves and the arm holes. There are three seams involved here instead of two: the front half of the arm hole, the back half of the arm hole, and the sleeve edge itself. You must first make the arm holes on the front and the back of the shirt into one segment. You will do this by making a "MultiSegment" seam.

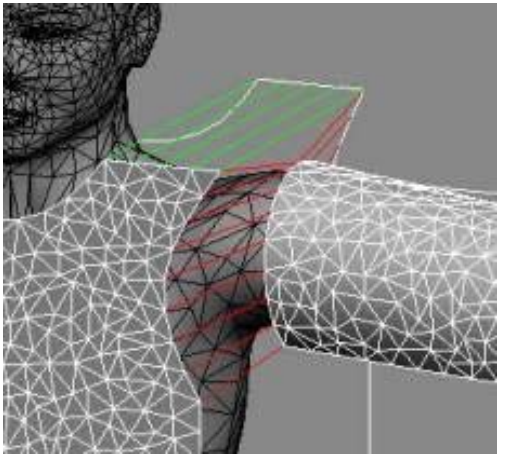
3. Select both segments for the arm hole on the front and the back of the shirt. It is important that you select the segments on the same side of the body on which you just made a shoulder seam. When both edges are selected, click Make MultiSegment on the Seams rollout.



Segments selected for making MultiSegment

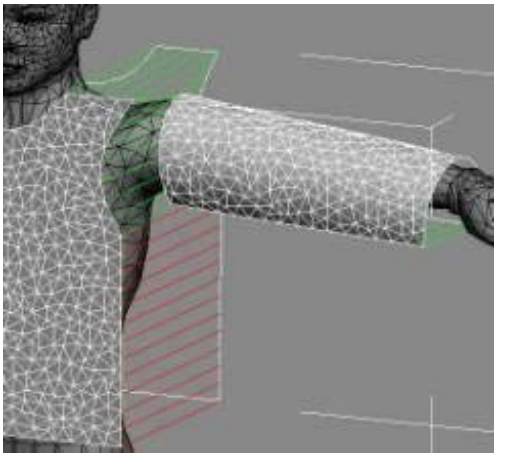
Now, if you deselect and select either the back or front segment, both will be selected or deselected because Garment Maker now considers them to be one segment.

4. Select the MultiSegment you just made, and then select the sleeve edge. Click Create Seam to attach the sleeve.



Seam attaching sleeve to body

5. Create the seams for the rest of the segments on that side of the body. Don't forget the underside of the sleeve.



Seams for left side of body

6. Use the same method to create the seams for the other side of the body.

Remember to create the shoulder seam first and then make the MultiSegment seam. When dealing with MultiSegment seams, the order of creation is important. If you attempt to create seams in the wrong order, you might get a "Seamline topology is wrong" error, and the seams will not be created. When dealing with MultiSegment seams, create the minimum number of seams necessary to make the MultiSegment seam match the topology of the other piece to that you are going to connect. In this case, you have an arm seam that is open at the bottom, and a MultiSegment that is open at both the top and the bottom. By closing the top of this MultiSegment with a seam at the shoulder, you've created proper topology to make the MultiSegment seam.

To recap this first lesson, you created a pattern for a shirt from standard splines, applied Garment Maker, positioned them over the character and then created the seams that will be used to sew the panels together. In the next tutorial, you will see how to make the flat panels look more like a shirt.

Designing a Shirt, Part 2

In this next tutorial, you'll take the patterns you built in the first tutorial, and you'll apply Cloth to begin the process of turning the panels into a shirt.

This lesson covers the following concepts:

- Assigning cloth and collision objects
- Bringing the seams together
- Assigning clothing properties
- Running the local simulation to fit a garment

1. Open *tutorial_2.max* from your *|tutorials|cloth* folder.

   This scene contains the Jester character and the shirt pattern with seams in place from the previous lesson. Now that all the seams are in place on the pattern, you will add the Cloth modifier to form the pieces into the shirt. The first task is to decide on the scale of the scene.

   If you use the Measure utility, you can see that the Jester character is about 77 3ds Max units tall. If we set one unit to one inch, what would make him 77 inches (6 feet, 5 inches) tall, including the hat, which seems reasonable. Since we want to use 1 3ds Max unit=1 inch, that means 1 unit=2.54cm, so the cm/unit setting in Cloth will be set to 2.54; this is the default.

2. Select the Shirt object, go to the Modify panel, and apply the Cloth modifier to it.

   Since we want cm/unit=2.54, there is no need to change this value, but please keep in mind that it is very important to set this value correctly before attempting a simulation.

   The Object Properties button on the Object rollout opens the Object Properties dialog, where you add objects to the simulation and assign them different properties.

3. Click the Object Properties button. In the left column of the Object Properties dialog, click the Shirt entry and then choose the Cloth radio button on the right.

   This sets the shirt to be a cloth object in the simulation.

   Take note of all the Cloth Properties parameters that can be adjusted when an object is set to be cloth. You can use these parameters to get the fabric type you want, or you can use a preset.

4. With the Shirt still highlighted in the left column, choose Cotton from the Presets drop-down list.

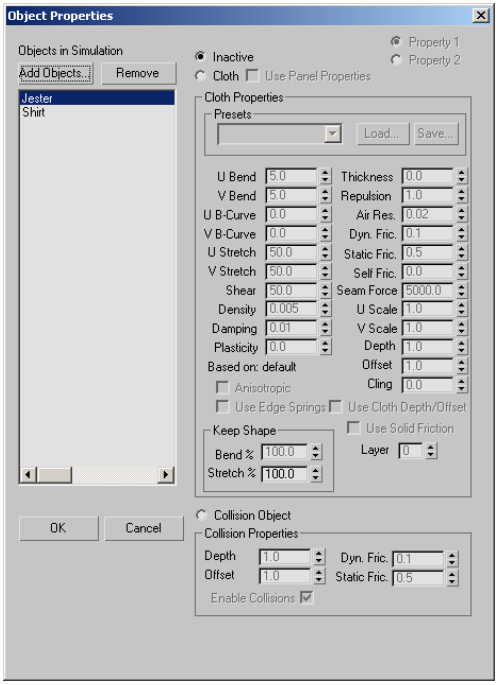
   This sets all of Cloth Properties to simulate cotton.

   If you were to simulate now, the shirt would simply fall to the floor because it's the only object in the simulation currently. You'll add an object for the cloth to collide and interact with.

5. On the Object Properties dialog, click the Add Objects button.

   This opens a list of objects in the scene.

6. Click the Jester and then click OK.

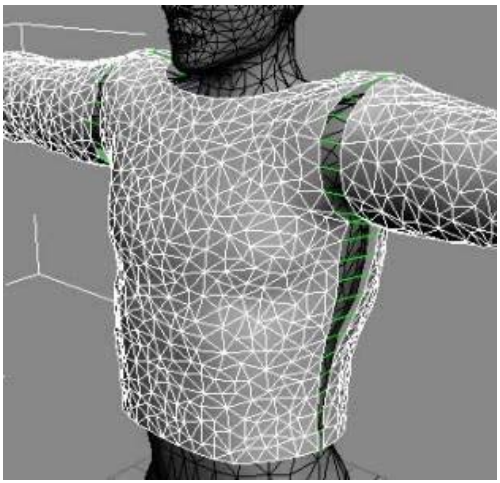


When you add objects to the simulation, it is the same thing as instancing the Cloth modifier to those objects. Each object that is part of the Cloth simulation will have a Cloth modifier assigned to it. Be aware of this as you set up your own simulations.

7. With Jester still highlighted in the left column, click the Collision Object radio button on the right near the bottom.
8. Set the Offset parameter to **0.25**, which will keep the cloth a quarter of a 3ds Max unit away from the body (the default of 1.0 is a little large for this scene).
9. Click OK to close the Object Properties dialog and set the parameters.

   At this point, you have set the shirt to react like cloth, and the Jester's body to collide with it. You are now ready to convert the panels into a shirt. You do this with a *local simulation*.

   Before you simulate sewing the garment together, you'll turn gravity off.
10. Scroll down to the Simulation Parameters rollout, and click the Gravity button so it is no longer highlighted and active.
11. In the Perspective viewport, zoom in a bit to get a closer look at the shirt, then still within the Cloth modifier, go to the Object rollout, and click then Simulate Local. When the seams have pulled the shirt mostly together, press the Esc key to stop the simulation.



   As you can see in the image above, the panels have pulled together and are draped over the Jester character. However, the seams have not come together to form a single garment and the green sewing springs are still visible. In order to get the seams to snap together completely, you will need to perform one more operation.
12. On the Simulation Parameters rollout, turn off Use Sewing Springs.

    The green lines disappear.
13. Turn Gravity back on, and then back on the Object rollout, click Simulate Local again.

14. Let the simulation run until you are satisfied with the fit, and then press the Esc key to stop it.

    Now the shirt is complete. Next, you can animate the character and simulate the cloth over the animation. But before you animate your character, you're going to give the shirt a pocket to add some detail to it.

Add a pocket:

Now that the shirt is coming together, you'll add a pocket to it in order to give it some more detail. This tutorial will introduce you to the idea of attaching one cloth object to another as well.

The following concepts are covered in this lesson:

- Garment Maker creation
- Creating and using groups
- Assigning separate cloth properties

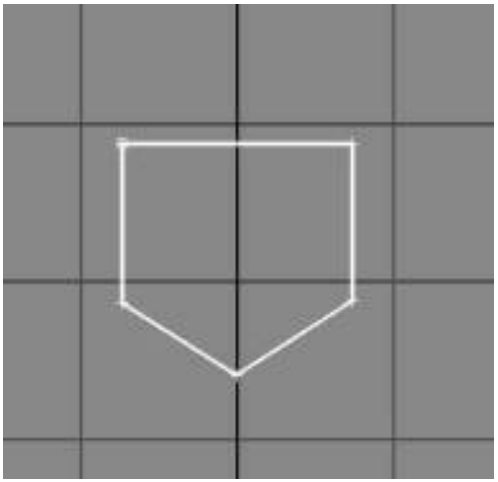
1. Load *tutorial_3.max* from your *|tutorials|cloth* folder.

   This scene contains the Jester character and the shirt simulated from the previous lesson. If the scene opens with the panels apart and the garment looking stretched out, there's an easy fix. Occasionally you will see a scene file with the panels not together and the triangles distorted. To fix this, just turn on Use Sewing Springs, click Reset State, and then use Simulate Local to rebuild the shirt as it was at the end of the previous tutorial.

   Now that the shirt is in place, you will add a pocket to it to make it look like a fancy T-shirt.

   You'll start by creating a pocket to add in the same way you made the shirt pattern.

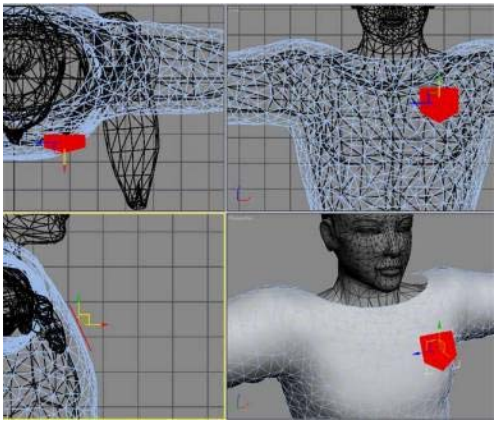
2. In the Top viewport, zoom into the front of the Jester's body, then draw out a pocket shape with the line tool using Create panel > Shapes > Line. Make the pocket an appropriate size for the shirt and name the object **Pocket**. Be sure to go to the Vertex sub-object level and break all the vertices.



Spline pocket in the Top viewport

3. With the Pocket object selected, apply the Garment Maker modifier to it.

4. Go to Panels sub-object level of the Garment Maker modifier, and then move the pocket into place just in front of the shirt. You might want to rotate the pocket a bit to more closely align it with the chest portion of the shirt. When you're done, exit the sub-object level.



Pocket positioned at the Panels sub-object level

Now that the pocket is in place, you will need to add it to the simulation.

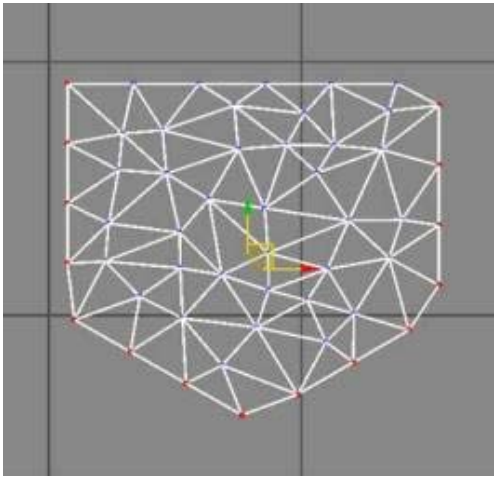
5. Select the shirt, and then click Object Properties. On the Object Properties dialog, click Add Objects to open a list of objects in the scene. Click Pocket and then click OK. With Pocket still selected in the left column, click the Cloth radio button on the right. Click OK to close the Object Properties dialog.

   Before attaching the pocket to the shirt, it's advisable to make the mesh densities of the two objects similar. Right now, the mesh density of the pocket is higher than the shirt, which can cause crumpling at simulation time.

6. Select the Pocket object, and then access the Garment Maker modifier in the stack. On the Object rollout, change the Density value so the mesh density of the pocket more closely matches that of the shirt. A value of **3.0** should work.

   Next you'll attach the pocket to the shirt. You can do this at the Group sub-object level of the Cloth modifier.

7. Select the Pocket object, and then go to the Group sub-object level of its Cloth modifier. This level lets you select vertices. Select the vertices at all edges of the pocket except the top edge, as shown below.



Pocket vertex selection

8. Click the Make Group button and name the group **PocketEdge**.

   You'll see a new group in the Group rollout list named "PocketEdge (unassigned)."

9. With this group still selected, click the Cloth button and pick the shirt by selecting it in the viewport or by pressing the H key and selecting it by name.

   Now the Group should be named "PocketEdge (cloth to Shirt)." This lets you know that you have attached the group of vertices to the shirt object as a piece of cloth.

10. Return to the base level of the Cloth modifier, so you are no longer in Group sub-object mode. Make sure Gravity is not active on the Simulation Parameters rollout.

11. Click Simulate Local to conform the pocket to the shirt.

12. This should take only a few frames, and you should also realize that this process will also further refine the shirt's fit itself, so don't let the simulation run too long.

Pocket conformed to the shirt

As you have seen, adding extra detail to a piece of clothing is not a very difficult process. Attaching one cloth object to another is simply a matter of creating a group of vertices and choosing the other cloth object to attach it to. In the next lesson you will expand on this knowledge to create a collar and cuffs for the shirt, as well as assign different material properties to them.

Next

Designing a Shirt, Part 3 (page 775)

Designing a Shirt, Part 3

Add a collar:

Now that you've had a taste of adding detail to a garment, it's time to look at some of the more advanced attributes within Cloth. In this tutorial, you'll add a collar and cuffs to a simple shirt design, and change their seams to create creases within the garment.

The concepts that will be covered in this lesson are as follows:

- Creating seams and positioning Garment Maker panels
- Using the Seam Strength and Seam Angle controls
- Simulating multiple times to get a garment into position

1. Load *tutorial_4.max* from your *|tutorials|cloth* folder.

   This scene contains a character and the shirt from the previous lesson. This shirt has some additions to it as shown in the following illustration. Two extra pieces have been added for the collar, and one extra piece per arm for a cuff. The cuff is a bit narrower than the sleeve.

Shirt layout with collar and cuffs added to the basic pattern

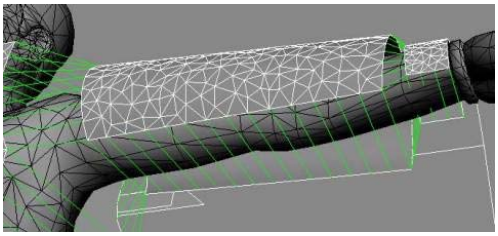
2. Select the shirt, and on the Modify panel, turn on the Garment Maker modifier so the panels move into place.

   The shirt is set up as in the previous lesson with most of the seams created for the arms, back and front of the shirt. You'll adjust the curve of the cuffs and collar and apply seams to them.

3. Go to Panels sub-object level of Garment Maker, and select one of the cuffs. In the Deformation group on the Panels rollout, choose Curved, and set the curve to **-5.0** around the Y-axis.

   Now that the cuff is curved around the arm, you can add its seams.

4. Go to the Seams sub-object level of Garment Maker and create a seam between the sleeve and the cuff. Then create the seams for under the sleeve and under the cuff. Create your seams in this order or you might get topology dependency errors.



Seams for the underarm and cuff

Now that you have made the seams for the cuff, you will edit the seam attaching it to the sleeve to get a cuff-like result. Where the cuff meets the sleeve, there should be a clear crease and a bunching of the sleeve.

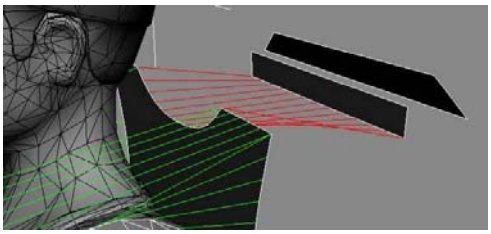
5. At the Seams sub-object level, select the seam (the green sewing springs) that joins the cuff and the sleeve. On the Seams rollout, set Crease Angle to **90.0** and Crease Strength to **100.0**.

   This will make the seam try to maintain an angle of 90 degrees.

6. Complete steps 3-5 for the other side of the body.

   Now you'll take a look at the collar. It would probably be best to make the seams for the collar first, and then change the curve afterward.

7. At the Seams sub-object level, create a seam between the back of the shirt and the bottom of the closest collar piece.



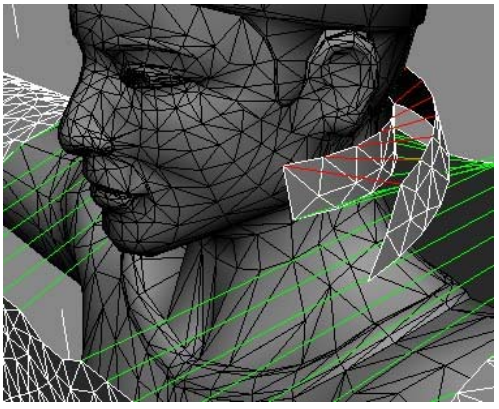
Seam from the back of the shirt to the bottom of the collar

8. Next, create a seam between the *tops* of the two collar pieces. If necessary, click the Reverse Seam button to straighten out the seam.

   Next you'll bend the collar panels and move them into place.

9. At the Panels sub-object level select the base of the collar and apply a curvature of **-3.0** around the X-axis. Select the other piece of the collar and apply a curvature of **-2.0** around the X-axis.

10. Select each of the collar places and move them into place around the neck and above the shoulders, as shown below.



Collar bent and positioned

Next you'll edit the seam of the collar as you did the cuffs. This will let the folded part of the collar stand out a bit.

11. Select the seam between the top of the two collar pieces in Seams sub-object mode. Set Crease Angle to **-75.0** and Crease Strength to **25.0**.

    Now you are ready to add the Cloth modifier and simulate.

12. Apply the Cloth modifier to the shirt.

13. On the Object Properties dialog, set the shirt to be cloth, and choose the Cotton preset from the drop-down list.

14. Add the Jester to the simulation, and make the Jester a collision object. Close the Object Properties dialog by clicking OK.
15. Turn off Gravity, and then Simulate Local with Use Sewing Springs on to bring the panels together.
16. Stop the simulation and then, on the Simulation Parameters rollout, turn off Use Sewing Springs.

    Turning off Use Sewing Springs tells Cloth to compute the seam angles and strength for the cuffs and collar.
17. Turn Gravity back on, and then Simulate Local again with Use Sewing Springs off to further refine the garment's position and fit.

    If you don't get the right result the first time, you might want to turn Use Sewing Springs back on and Reset State. This will allow you to perform the local simulation again.

Simulated shirt with collar and cuffs

This lesson has provided you with additional ways to control how your fabric behaves and is joined together. In the next lesson you'll look at how you can further refine the look and behavior of your clothing by assigning different cloth properties to the panels of garments.

Apply various cloth settings to different parts of the shirt:

In the last lesson you looked at different controls that help define how your fabric behaves. In this lesson you'll apply different cloth settings to various parts of the shirt to create a more convincing look.

The concepts that will be covered in this tutorial are as follows:

- Assigning separate Cloth properties for panels
- Assigning different materials for panels
- Assigning separate Cloth properties with a material

1. Load *tutorial_5.max* from your *|tutorials|cloth* folder.

   This scene contains a character and the shirt from the previous lesson. You'll add some different properties to the cloth panels themselves.
2. Select the shirt and then, on the Cloth modifier Object rollout, click Object Properties to open the Object Properties dialog. Highlight the Shirt entry in the left column and then turn on Use Panel Properties. Click OK to exit the dialog.

   This will let you set the cloth properties for the entire shirt on a panel-by-panel basis.
3. Go to the Panel sub-object level of Cloth and select one of the cuffs. It will turn red it indicate that it's selected.

   You can change all of the parameters for how the fabric reacts here on the Panel rollout.
4. From the Presets drop-down list, choose Generic Heavy.

   This sets the cuff to deform like a heavy or stiff piece of fabric.
5. Select the different panels of the collar and the other cuff and set them to the Generic Heavy

preset. Be sure to choose the preset even if it is already displayed in the list.

6. Select each of the other shirt panels, and set the preset to Cotton.

   This will make most of the shirt behave like cotton except for the collar and cuffs, which will be heavier and less flexible, as if they were starched.

   Now it's time to rerun the simulation.

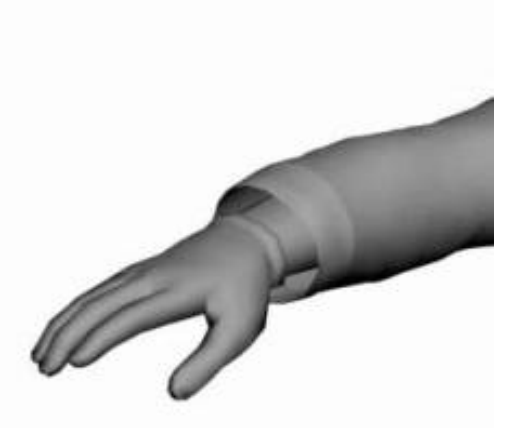
7. Exit the Panel sub-object level and go to the Object rollout of the Cloth modifier. Be sure Use Sewing Springs is on in the Simulation Parameters rollout, and then click Reset State from the Selected Object Manip group of the Object rollout.

   This resets the state of the shirt so you can run the local simulation again.

8. Run the local simulation again, first with Use Sewing Springs on for a bit, and then run the local simulation with Use Sewing Springs turned off. You might also use Simulate Local (damped), which adds a heavy damping to the fabric as it simulates.

9. If you are not satisfied with the results, click Erase Simulation and then rerun the simulation until you like the positioning and drape of the shirt.

   Now that you have different fabric properties for the cuffs and the collar, you'll set up some different materials and densities. If you take a look at the end of the cuff, you will see it seems a bit low-poly and chunky.



Slightly chunky-looking cuff

10. If necessary, select the shirt, and then go down the modifier stack to the Garment Maker modifier.

    You're going to change the density of different parts of the shirt next. In order to do this so you don't have to re-simulate the garment afterwards, you'll first check to make sure that you preserve the shirt's position.

11. In the Garment Maker modifier, make sure the Preserved Surface radio button is chosen.

12. Go to the Panels sub-object level and select one of the cuffs. On the Panels rollout, change Density to **3.0** and set the Mat ID to **2**. Do this for the other cuff as well.

    This will let you apply a different material to the cuffs only.

13. Select each panel of the collar and change its Density to **2.0** and its Mat ID to **2**.

14. Use the Material Editor to create a Multi/Sub-Object material with two sub-material slots. Change the two sub-materials to any colors you like, apply the material to the shirt, and then render.

Smooth cuffs with separate materials applied

You changed the cloth properties via the Panel sub-object level; you'll now learn about an alternative method that can add some flexibility to assigning cloth properties. You'll use a grayscale map to determine which parts of the shirt are made of which types of fabric.

15. Go back up the stack to the Cloth modifier, and open the Object Properties dialog by clicking Object Properties on the Object rollout.
16. Highlight the Shirt entry on the left, and then *turn off* Use Panel Properties.
17. Choose the Cotton preset.

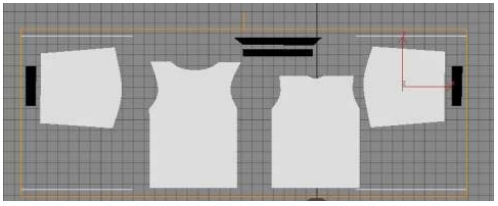
    Now the entire shirt is set back to cotton.
18. In the upper-right corner of the Object Properties dialog, click the Property 2 radio button. Choose the Cotton Generic Heavy preset.
19. Click OK to exit the dialog.

    Now you have two different sets of cloth properties you can modify and assign to the shirt.
20. Open the Cloth modifier's Material Params rollout.

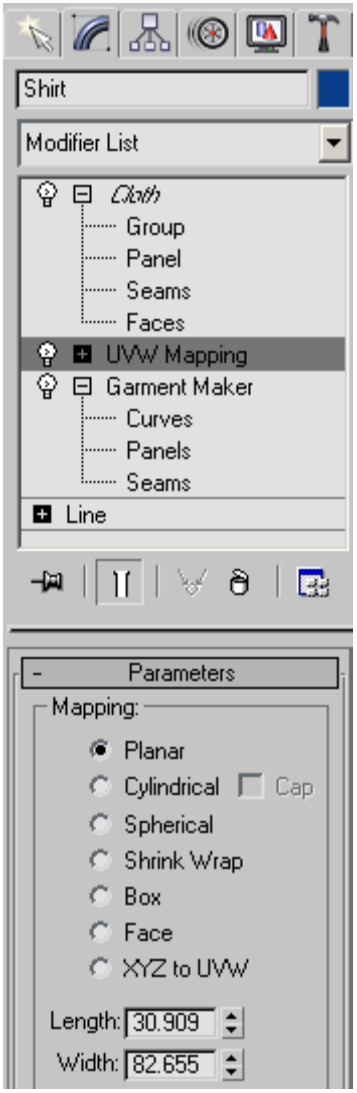
    Note: This rollout is available only when a single object is selected.

    The Interpolate option is currently active. This option lets you move the slider to interpolate between the two properties you just set for the cloth, and even animate between them if you wish. But for now you'll use the other option: Texture Map. This lets you to use a grayscale texture map to assign fabric properties. White pixels will assign Property 1, black pixels will assign Property 2, and values in between will blend between the two sets of properties.
21. Open the Material Editor and create a new material. As the Diffuse map type choose Bitmap and choose the *shirtprop.bmp* from your *\maps* folder.
22. Apply this material to the shirt.
23. Reset the initial state, making sure Use Sewing Springs is on. Go to the Object rollout of the Garment Maker modifier and choose the Flat Panels option.

    This lays out the panels in a manner that is appropriate for UVW mapping.
24. Above the Garment Maker modifier apply a UVW Map modifier. Keep the Planar default mapping type and adjust the size to fit properly. Make sure Show End Result toggle is off below the modifier stack display so you can see the panels.



UVW modifier in the Top viewport



Modify panel with UVW Mapping modifier

25. Go back up to the Cloth modifier in the stack.

26. On the Material Params rollout, choose the Texture Map option and then click the None button to get the texture. On the Material Map Browser dialog choose Browse From > Mtl Editor, and then choose the Diffuse map you just added to your shirt.

You're now ready to simulate again.

27. Use Simulate Local as before to conform the shirt to the character with the new settings.

Now the fabric parameters are defined by the black-and-white map to make the cuffs and collar a bit stiffer than the rest of the shirt. You can now apply any material you want to the shirt.

Simulation with cuffs and collar properties set by material

As you can see, giving a single piece of clothing multiple cloth properties is not difficult, and can generate results that would be impossible otherwise. Now that you can construct garments and give them properties to make them behave as you would like, you'll start looking into how you can refine the design of the clothes you build so they fit the characters better.

Tailoring and Fine-Tuning

As you begin to create more complex clothing, you're most likely going to want to create the garments for your characters, then be able to go back and refine them to make them fit better. In essence, you'll be acting like a virtual tailor. This

tutorial introduces you to the traditional sewing concept of darts, and how they can help you build better clothing.

The concepts that will be covered in this tutorial are as follows:

- Using darts with Garment Maker
- Creating seams for darts
- Modifying darts after simulation to get a better fit

Fit a dress with darts:

1. Load *tutorial_6.max* from *|tutorials|cloth* folder.

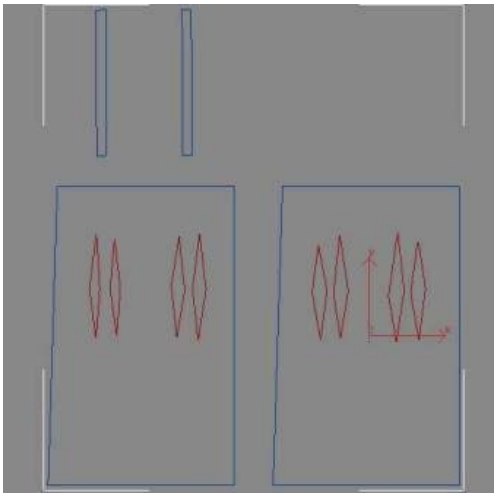
   This scene contains a character model and a pattern for a sun dress. This sun dress has darts in it to help it fit the character's body closely while still being a very simple pattern.

2. Select the *SunDress* object.

   The darts in the pattern appear as thin diamonds.

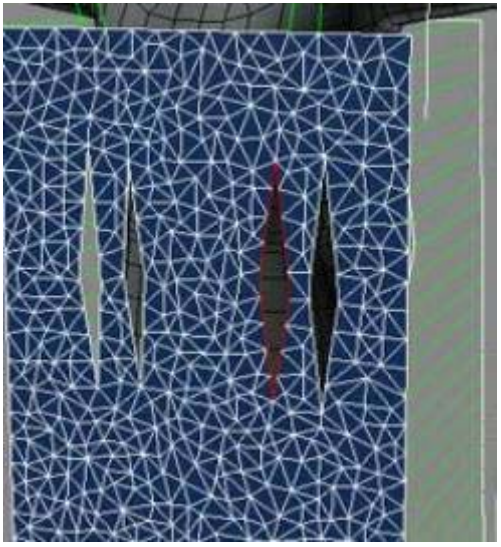
3. Go to the Modify panel and turn on the Garment Maker modifier.

   Most of the seams for the dress are already made. The ones you'll focus on are the darts.



Darts marked in red

4. Go to the Seams sub-object level of Garment Maker. Select the two seams of one of the darts and then click Create Seam.



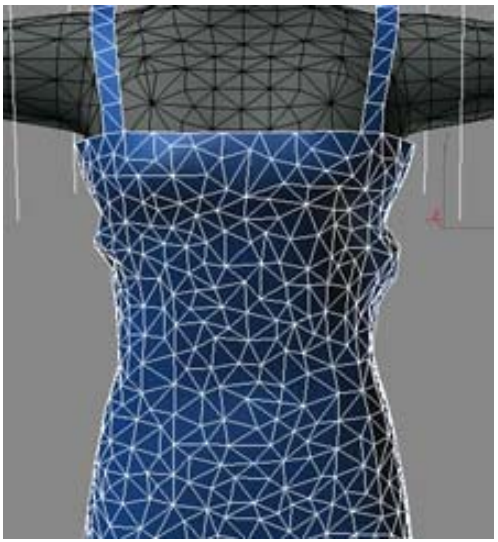
Seam made for one dart (far right) and selected edges to create a seam for the next dart

5. Proceed around the dress making seams for each dart.
6. Apply the Cloth modifier to the dress.

7. On the Object rollout click Object Properties. Highlight the SunDress entry in the list on the left, click the Cloth radio button, and then choose the Cotton preset from the drop-down list.
8. Click the Add Object button and then add the Girl to the simulation. With the Girl entry highlighted click the Collision Object option. Click OK to exit the dialog.
9. On the Object rollout choose Simulate Local (damped). Once your dress is partially formed to the figure, stop the simulation, turn off Use Sewing Springs in the Simulation rollout, and then simulate locally again for a bit.

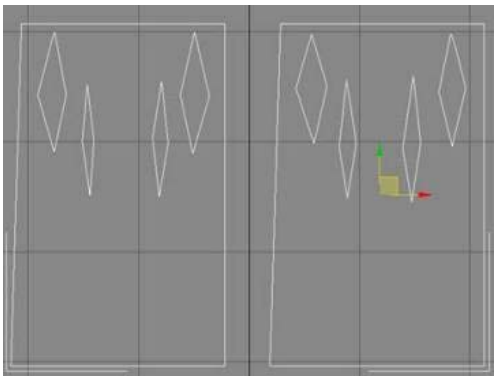
   The shoulder straps are floating too high above the shoulders, so you'll decrease the offset a bit.
10. Open the Object Properties dialog again and choose the Girl entry in the list at the left. In the Collision Properties group reduce the Offset value to **0.6**. Click OK to close the dialog.
11. Click Simulate Local (damped) to tighten up the dress.

    The resulting dress has some bunching on both sides under the chest. This bunching is what the darts are designed to minimize or eliminate. You should be able to get a better fit by repositioning the darts and making them a little larger.



Bunching on both sides of the dress

12. Go to the spline level at the bottom of the modifier stack and then access the Vertex sub-object level. In the Top viewport, reposition the outside darts to be larger, and position them more toward the top of the dress as shown below.



Darts moved up and widened

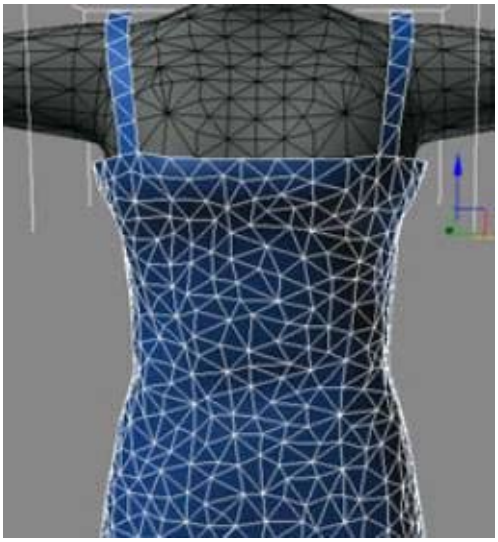
13. Garment Maker doesn't register changes in the spline shape until the mesh is regenerated, so now you need to click the Mesh It And Preserve button, which lets you keep the dress in place as it adjusts to the new dart positioning. If you

clicked the Mesh It! button instead, the dress would revert to the pre-sewn configuration.

14. Go up to the Cloth modifier, turn on Simulation Rollout > Use Sewing Springs, and then click Reset State.

15. Run the simulation locally again until you're satisfied.

    You should get a much better fitting dress.



Results after manipulating the darts

Using Cloth with Bipeds

Cloth is a complex system, so it makes sense to learn how it functions in concert with another character animation tool, namely the Biped functionality in **3ds max**.

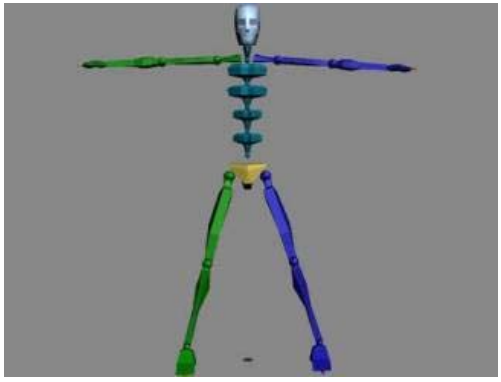
The following concepts are covered in this tutorial:

- How to slow down the character's initial pose so the initial Cloth simulation can occur. The idea here is that motion-capture data imported into both products will position a character at frame 0, which can cause problems for Cloth because it wants to simulate over at least 30 to 90 frames before motion begins, generally in a neutral pose.
- Truncating a simulation
- Capturing an initial state

Clothe an animated biped:

1. Load *tutorial_7.max* from your *|tutorials|cloth* folder.

   This scene has a biped standing in the "Da Vinci" pose.



Biped in Da Vinci pose

2. Select all the biped parts and then go to the Motion panel.
3. On the Copy/Paste rollout, click Copy Posture.

   Now this posture is saved for you to get later.
4. On the Motion Capture rollout, click Load Motion Capture File, and then load the file *backkick.bip* from your *|tutorials|cloth* folder. Click OK through the dialogs that follow, accepting the default settings.
5. Open the Dope Sheet for Track View, and select all of the Biped keys. Move the keys 30 frames to the right.

   This will give you 30 frames to transition between the copied pose and the first motion-capture frame.

6. At frame 0, on the Motion Panel > Copy/Paste rollout, click Paste Posture.
7. On the Key Info rollout click Set Key.

   Now when you scrub the time slider your animation should transition smoothly between the Da Vinci pose and the first frame of the motion capture.
8. Unhide the Shirt object.
9. Select the Shirt object and then go to the Modify panel and click Cloth modifier > Object rollout > Simulation group > Simulate to get the shirt to deform. At frame 30, press Esc to halt the simulation.
10. At frame 30, click Cloth modifier > Object rollout > Selected Object Manip group > Set Initial State.

    This sets the initial state of the shirt to be in sync with the first frame of the motion capture. Because Cloth requires some pre-roll for the simulation, it provides you with the tools needed to copy the cloth at any stage back to frame 0.
11. Next, go to frame 0 and click Truncate Simulation.

    This removes the simulation after frame 0.
12. Choose File > New, and on the New Scene options dialog, choose Keep Objects And Hierarchy.

    This removes all animation from the scene.
13. Import the motion capture file again. The cloth will be in sync with it at frame 0, and you can simulate the rest of the animation at that point.

    This tutorial gave you a method for "staging" your Cloth simulation.

Next

Creating Pleats (page 784)

Creating Pleats

In this final tutorial, you will learn more about creating specific pleats within a garment to make it look as if it's just been ironed and pressed.

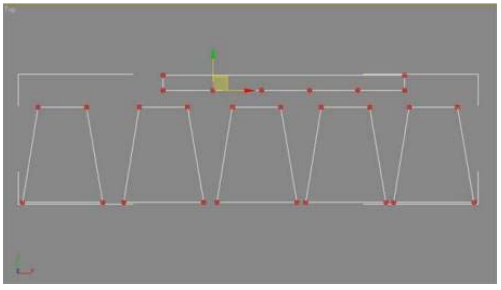
The concepts that will be covered in this tutorial are as follows:

- Using a pattern with pleats in Garment Maker
- Creating seams for pleats

Sew the skirt sections together:

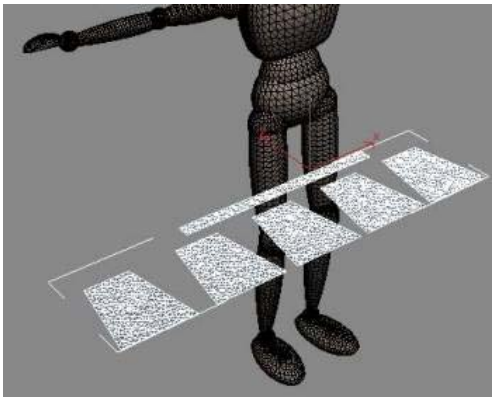
1. Load *tutorial_8.max* from your *|tutorials|cloth* folder.

   This scene contains a mannequin figure and a pattern for a pleated skirt. This skirt has been broken into several sections for a pleated look when it gets sewn together.
2. Select the *Skirt* object.



Skirt pattern

   This pattern object contains five sections that will have pleats between them. You'll connect the five sections to the five segments on the bottom of the waistband portion of the dress.
3. Apply the Garment Maker modifier to the *Skirt* object.

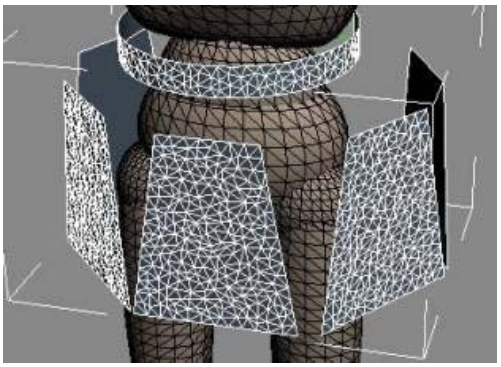


Garment Maker applied to the skirt panels

Next you'll position and rotate the pattern into place at the Panels sub-object level of Garment Maker.

4. Go to Panels sub-object level and then position and rotate the waistband portion of the pattern near the character's waist.
5. In the Panels rollout > Deformation group choose Curved. Enter a Curvature value of **-1.7** around the X-axis.

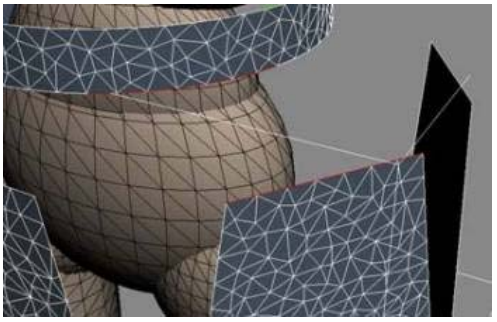
   This bends the waistband portion of the skirt around the character's waist.
6. Move and rotate the skirt panels so they encircle the character, as shown below. Take your time and rotate the view around the character to get a better sense of where the panels are in relation to one another.



Panels rotated and placed around the character

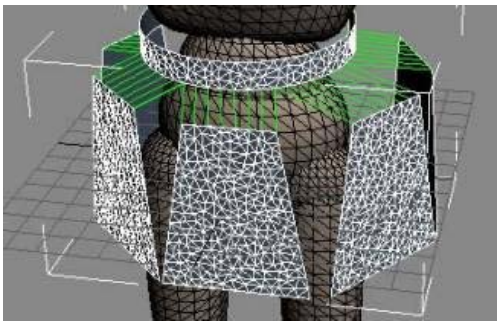
Once the panels are in place you can make seams to attach each panel to the waistband.

7. At the Seams sub-object level of Garment Maker, select a segment on the bottom edge on the waistband and the corresponding edge on the top of a skirt panel.



Edges selected to make a seam

8. On the Seams rollout click Create Seam.
9. Attach the remaining panels to the waistband with additional seams.

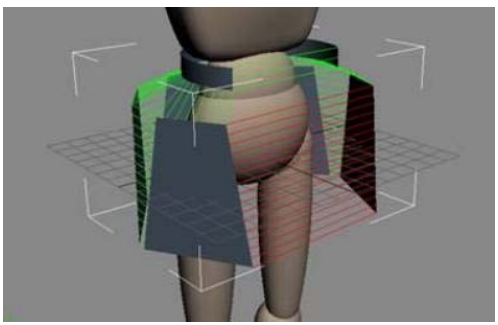


Seams created attaching the waist band to the panels

10. Create a seam for the back of the waistband to close it off.

    Each adjacent pair of skirt panels need a seam between them to keep them together and define a pleat.

11. Select the edges of the two back panels to create a seam between them and then click Create Seam.



Seam created between back panels of the skirt

12. With this seam still selected, go to the Seams rollout and change Crease Angle to **90.0** and Crease Strength to **25.0**.

    Setting Crease Angle to 90 makes the seam try to achieve a 90–degree angle during simulation. The Crease Strength setting defines how hard the seam will try to reach the set crease angle. All of this happens during simulation when Use Sewing Springs is off.

13. Repeat steps 11 and 12 with each pair of adjacent panels in the skirt.

14. Exit the sub-object level and apply the Cloth modifier to the Skirt object.

15. On the Object rollout click Object Properties.

16. On the Object Properties dialog, highlight the Skirt entry in the Objects In Simulation list and choose the Cloth option to designate the skirt as a cloth object.

17. From the Presets drop-down list choose Cotton.

18. Click the Add Objects button and add Manny to the simulation. Choose the Collision Object radio button to designate the mannequin as a collision object. Click OK to exit the dialog.

    Now it's time to simulate and see how the dress looks.

19. On the Simulation parameters Rollout turn Gravity off and make sure Use Sewing Springs is on. Click Simulate Local (damped) and let the sewing springs pull the skirt together for a few seconds. Press the Esc key to stop the simulation.

20. Turn off Use Sewing Springs and turn on Gravity.

21. Run the local simulation again to snap the seams together and to define the pleats. After a couple of frames, press the Esc key to halt the simulation.

Skirt after simulation is complete