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nCloth Advanced Techniques

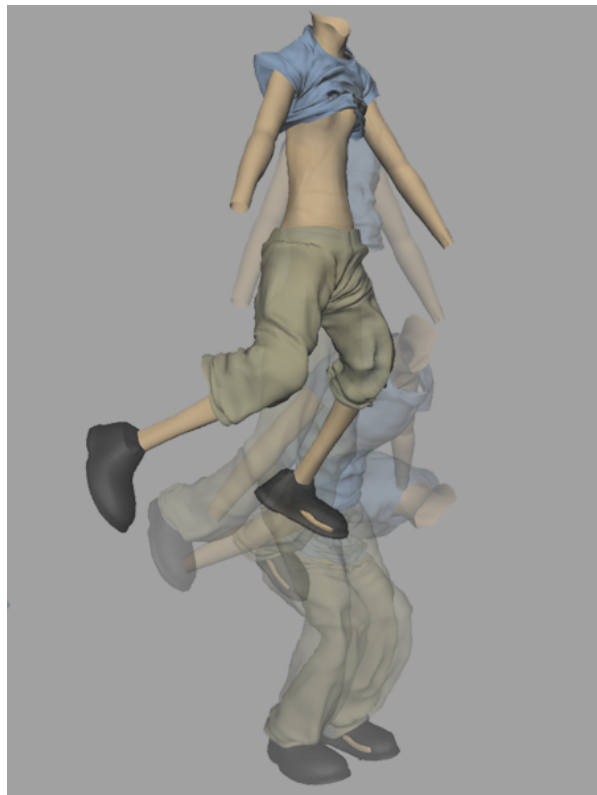
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nCloth Advanced Techniques



Overview



The nCloth Advanced Techniques tutorial demonstrates a workflow for simulating high resolution clothing mesh using nCloth. In this tutorial, two lower resolution versions of a high resolution mesh clothing are converted to nCloth and then simulated. Using a wrap deformer, the nCloth objects become influence objects for the high resolution mesh clothing, which then behaves

the same as the simulated nCloth. Using this workflow, you can quickly create animated behaviors unique to simulated cloth using high resolution meshes.

This tutorial describes methods for identifying problem areas in your nCloth simulations and explains how to resolve simulation issues, such as inaccurate collisions and self collisions, which often lead to interpenetrations between colliding objects. Inaccurate collisions are at play when the components participating in collisions do not accurately detect the presence of other participating components. This can happen when simulating models with complex geometry. It also explains the importance of setting key Nucleus solver attributes early in the simulation process to ensure better results in more complex nCloth simulations. When simulating complex models, the default solver settings often need to be adjusted to optimize your nCloth.

Use of any data from *The Spine* in this tutorial is courtesy of the National Film Board of Canada.

When is this workflow useful?

This workflow is useful for, but not limited to the following scenarios:

- Simulating highly detailed polygon meshes.
- Simulating clothing from various mesh resolutions, which can then be used for characters in the background, mid ground, and foreground of your scene.
- Simulating the same clothing for multiple characters in a scene that have similar scale and shape.

Why is this workflow useful?

- Reduces the amount of simulation time and computing resources, allowing you to spend more time testing and adjusting nCloth attribute settings.
- Shorter simulation and caching durations provide quicker feedback on how specific attribute adjustments affect nCloth behavior.
- Lets you develop a better understanding of how your nCloth is behaving and responding to your nCloth attribute settings.
- Lets you troubleshoot simulation problems using a low resolution proxy mesh, and then apply the solutions to high resolution mesh nCloth objects.

The nCloth Advanced Techniques tutorials assume that you have a familiarity with nCloth in your Maya scenes, and have completed the nCloth tutorials

from the Getting Started with Maya sections of Maya Help. This chapter includes the following lessons:

- [Lesson 1: Converting the pants to nCloth and setting up the simulation](#) (page 6)
- [Lesson 2: Simulating the pants in a static stance](#) (page 12)
- [Lesson 3: Wrapping the high resolution mesh and simulating the pants during animation](#) (page 17)
- [Lesson 4: Simulating the low resolution shirt](#) (page 36)
- [Lesson 5: Simulating medium resolution meshes using custom nCloth attribute presets](#) (page 44)

Preparing for the lessons

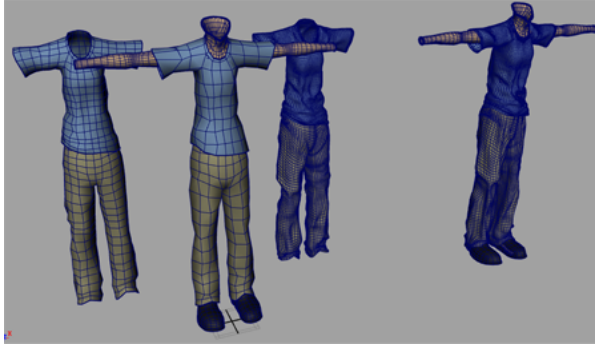
To ensure the lessons work as described, do these steps before beginning.

- 1 Make sure you understand the basic concepts of polygon modeling, animation, and nCloth.
- 2 If you have not already done so, download the nCloth Advanced Techniques Lesson Data from the following location: <http://www.autodesk.com/maya-advancedtechniques>. Then, set the `nClothAdvancedTutorials` directory as your Maya project.
- 3 Select the **nDynamics** menu set. Unless otherwise noted, the instructions in this chapter assume you've already selected the **nDynamics** menu set.

About the tutorial assets

Throughout this tutorial, you use four variations of the character's polygon mesh clothing: a low resolution, medium resolution, high resolution, and reference character version. To view the tutorial assets, open `Character_Multiple_Resolution.mb` in Maya. The following sections describe each asset.

Use of any data from *The Spine* in this tutorial is courtesy of the National Film Board of Canada.



From left to right, the assets are, the medium resolution shirt and pants, low resolution shirt and pants, high resolution shirt and pants, and reference character.

Low resolution polygon meshes

The low resolution shirt (Shirt_LowRes) and pants (Pants_LowRes) objects are the low resolution meshes that you convert to nCloth and simulate. Most lessons in this tutorial focus on optimizing the simulation of these low resolution objects. The low resolution shirt and pants are used as the wrap influence objects for the wrap deformer. The Shirt_LowRes object consists of 180 faces and the Pants_LowRes object consists of 244 faces.

High resolution polygon meshes

The high resolution shirt (Shirt_HighRes) and pants (Pants_HighRes) objects are the high resolution meshes used as the deform objects for the wrap deformer. At various stages of this tutorial, you show these meshes in the scene view to observe how the wrap deformer meshes behave when influenced by the low resolution nCloth shirt and pants. The Shirt_HighRes object consists of 6510 faces and the Pants_HighRes object consists of 5712 faces.

Medium resolution polygon meshes

In the final lesson of the tutorial, you apply a custom nCloth attribute preset to the medium shirt (Shirt_MedRes) and pants (Pants_MedRes) objects. The nCloth preset is created from the attribute values used for the low resolution nCloth simulation. Like the low resolution shirt and pants, the medium resolution objects are also used as the wrap influence objects for the wrap deformer.

Reference Character

The reference character (Reference_Character) is a high resolution version of the character and clothing (shirt and pants), which is animated using a cached simulation. It represents the final high resolution mesh that you want to emulate when simulating the low resolution meshes with the wrap deformer. At various stages of the tutorial, you can display the reference character object in the scene view to compare with your current low resolution nCloth simulation.

In the tutorial scene files, the reference character appears hidden in the Layer editor. To display the object, turn on Visible in the Layer Display editor.

For information about the Layer Editor, see *Display Layer editor* in the *Basics* guide.

General modeling considerations

In this tutorial, the terms low, medium, and high resolution are used to distinguish each mesh. The terminology is not intended to define the composition of a low, medium, or high resolution mesh, but rather to describe the mesh's general characteristics. When modeling geometry for nCloth, consider the following guidelines:

- High resolution meshes typically look better in a scene than low or medium resolution meshes; however, they take considerably more time to simulate. It is important to establish where in the scene the character wearing the nCloth is to appear. The character's placement helps determine the level of detail for its clothing mesh.

For example, if the nCloth is used for a character in the foreground of your scene you will want to use a high or medium resolution mesh. If the character is a stand-in or in the background of the scene, lower resolution meshes may be sufficient.

- This tutorial assumes that no original low polygonal meshes were created, as all models are derived from the high-resolution meshes. The low and medium resolution meshes have been modeled based on the original high resolution mesh by superimposing the lower resolution meshes on top of the high resolution mesh. Modeling the lower resolution mesh on top of the original high resolution mesh lets you use the high resolution mesh to quickly identify problem areas in your simulation, such as the crotch and knees in the nCloth pants.
- You can use **Smooth Polygon Preview** mode to see what your low resolution mesh looks like with a higher polygon count. Be aware that

when the mesh is converted to nCloth, it uses the base mesh and not the preview subdivided mesh.

- When modeling your low resolution meshes, try to superimpose them as closely as possible to the high resolution mesh. Doing this minimizes offsets between the meshes during the simulation, which can cause interpenetrations between the character's body and the high resolution mesh. These interpenetrations may not appear in the static frames (initial set up) of your simulation, but may appear in frames in which the character is animated. Be aware that interpenetrations are easier to resolve in the initial frames of your simulation.
- It is a best practice to model your mesh using equal sized quads, as this directly impacts how your nCloth behaves in the simulation. nCloth created from input meshes with similar sized polygons tend to produce more accurate collisions than nCloth meshes with polygons of varied sizes. Typically, meshes created from uniform quads provide better results in other character creation tasks, such UV layout, skinning, and deformation. For more information, see *Optimizing geometry for nCloth conversion* in the *nDynamics* guide.

Lesson 1: Converting the pants to nCloth and setting up the simulation

Before setting up the simulation environment, you need to convert the low resolution pants mesh (Pants_LowRes) to an nCloth object. When the nCloth object is created, an nClothShape and a Nucleus node are created. You can then set up the simulation environment.

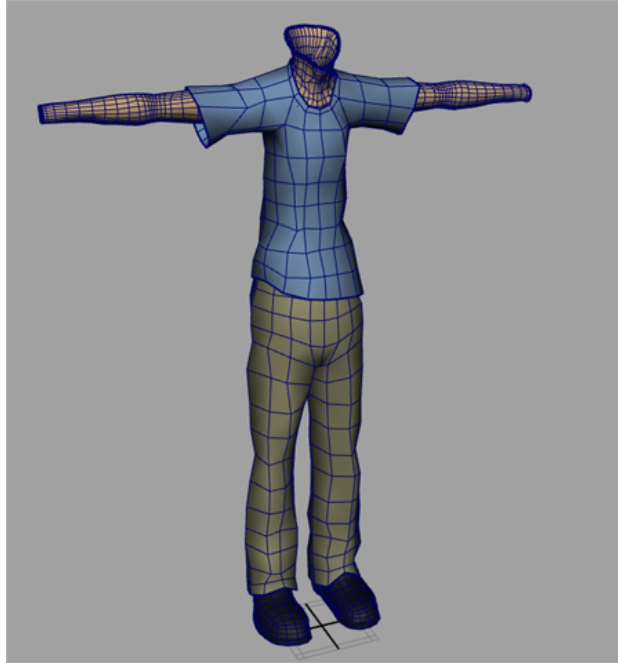
In this lesson, you will:

- Convert the Pants_LowRes object to an nCloth object.
- Convert the Body and Shoe objects to passive collision objects.
- Set Nucleus solver properties, such as **Time Attributes** and **Scale Attributes**.

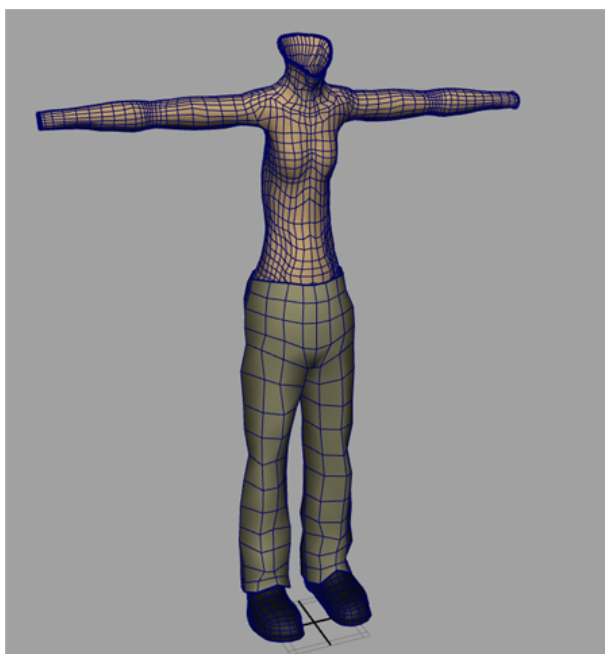
Converting the pants to nCloth


To convert the pants to nCloth

- 1 Open `Character_LowRes_1.mb` in Maya.

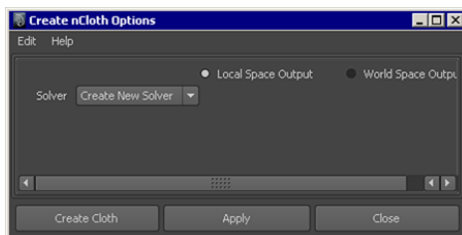


- 2 Make sure that only the low resolution pants (Pants_LowRes), Body, and Shoes are displayed in the scene view.
If other objects are displayed, such as the Shirt_LowRes object, hide them by selecting each object in the **Outliner** and selecting **Display > Hide > Hide Selection**.

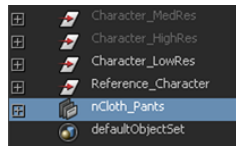


- 3 Select the `Pants_LowRes` object and select **nMesh > Create nCloth >**  .

The **Create nCloth Options** window appears.



- 4 Select **Edit > Reset Settings**.
- 5 Click **Create Cloth**.
The low resolution pants are converted to an nCloth object, and its Maya Nucleus solver is created.
- 6 To ensure that all nCloth objects you create in this tutorial are easy to identify in your scene, rename the pants nCloth object. To do this, in the **Outliner**, double-click `nCloth1`, type `nCloth_Pants`, and press Enter.



7 Play back your simulation.

When you playback the simulation, you notice that the nCloth is not responding to the Nucleus forces, meaning it is not being simulated. In the next steps, you adjust the scene’s start frame so that your nCloth is simulated.

Setting up the simulation

Before you begin simulating nCloth, it is important to adjust the Nucleus solver properties to suit your simulation. The Maya Nucleus solver properties control internal forces that affect all of the nodes that are members of a particular solver system.

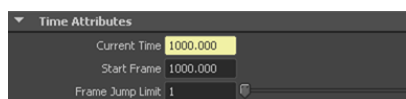
One of the most important Nucleus solver attributes to be aware of is **Space Scale**. When **Space Scale** is set to its default value of 1, the Nucleus solver applies **Gravity** and **Wind** to objects as if the objects were scaled in meters. In some production pipelines, the geometry that is used in nCloth simulation is modeled as life size or in large scale, and so **Space Scale** needs to be adjusted to compensate for the difference in scale. For more information, see *Space Scale* in the *nDynamics* guide.

Setting Nucleus solver attributes

For this tutorial, the Time Slider settings specify the Playback time of the scene to start at frame 1000 and end at frame 1150. By default, the Nucleus solver starts simulations at frame 1. To begin simulating the scene, set the **Start Frame** of the simulation to frame 1000.

To set the simulation Start Frame

- 1 In the **Attribute Editor**, select the **nucleus1** tab.
- 2 In the **Time Attributes** section, set the **Start Frame** to 1000.



- 3 Rewind to the start frame and play back your simulation.

When you play back the simulation, you notice that the nCloth pants are falling under the influence of gravity generated by the Nucleus solver. However, they fall too slowly to be realistic. This occurs when the scale of the objects in your scene do not match the scale of the Nucleus solver system. Since the Nucleus solver simulates as if centimeters were meters, you need to adjust the **Space Scale** of the Maya Nucleus solver. In this scene, the character and clothing meshes have been modeled using centimeters as the Maya scene units. Therefore, to simulate your nCloth objects (which were modeled life-size), you need to set **Space Scale** to 0.01.

To edit Space Scale

- 1 In the Nucleus node **Attribute Editor**, in the **Scale Attributes** section, set the **Space Scale** to 0.01.



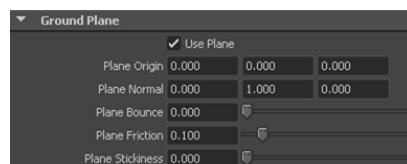
When you reduce the **Space Scale** attribute, Maya evaluates the pants as if they are a much smaller object. The result is a visibly increased gravitational affect on the nCloth pants object.

- 2 Play back your simulation.

When you playback the simulation, you notice that the nCloth pants now fall from the start position at a realistic speed, however they are falling out of the scene. To stop the pants from falling out of the scene view, turn on the Nucleus **Ground Plane**.

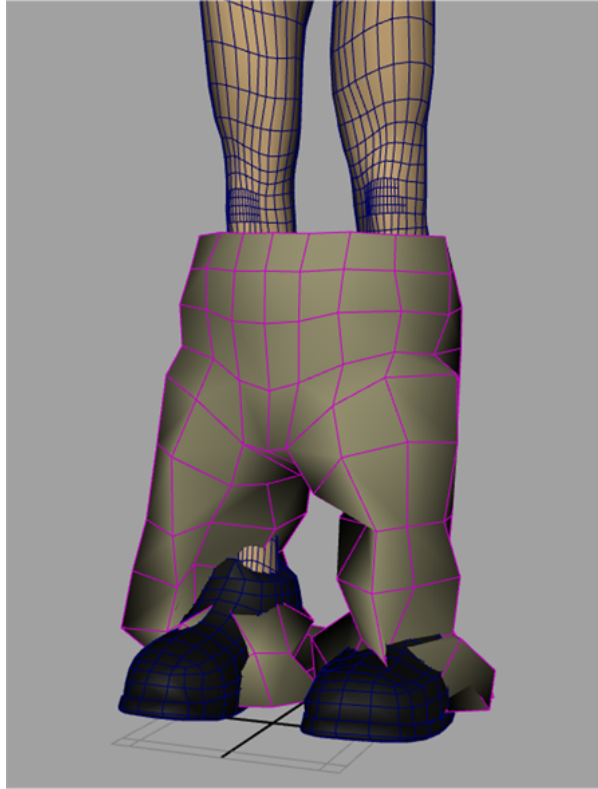
To turn on the Nucleus Ground Plane

- 1 In the Nucleus node Attribute Editor, in the **Ground Plane** section, turn on **Use Plane**.



- 2 Play back the simulation.

When you play back the simulation, you notice that the pants are not colliding with the body and shoe objects. This is because the body and shoe meshes are not yet part of the nCloth's Nucleus system. In the next step, you convert these objects to passive collision objects.

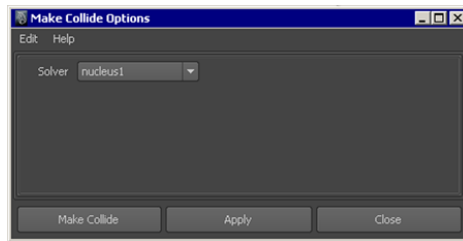


Converting the body and shoes to passive collision objects

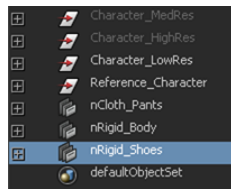
The last step in setting up the simulation is to convert the body and shoe meshes to passive collision objects. As passive collision objects, the body and shoe meshes will collide with the nCloth pants object.

To convert the body and shoe meshes to collision objects

- 1 In the scene view, Shift-select the body and shoe meshes, and select **nMesh > Create Passive Collider >** .
The **Make Collide Options** window appears.



- 2 From the **Solver** drop-down list, select **nucleus1**.
- 3 Click **Make Collide**.
Two **nRigidShape** nodes (**nRigidShape1** and **nRigidShape2**) appear in the **Outliner**.
- 4 To ensure the body and shoe objects are easy to identify in your scene, rename the **nRigidShape** nodes in the **Outliner**. To do this, double-click *nRigidShape1*, type *nRigid_Body*, and press Enter. Do the same for the shoes object by renaming *nRigidShape2* to *nRigid_Shoes*.



Lesson 2: Simulating the pants in a static stance

Before simulating nCloth on an animated character, it is important to ensure that your nCloth simulates correctly while the character is at rest or in a static stance. By allowing the nCloth to settle, it is easier to identify problems in the simulation and apply the proper adjustments before your simulation becomes too complex and hard to diagnose.

In this lesson, you will:

- Create a **Point to Surface** constraint to constrain the pants to the nRigid_Body object.
- Edit **Stretch Resistance** and **Compression Resistance**.
- Edit **Damp** to decrease the amount of time required for the simulated nCloth to reach its rest state.

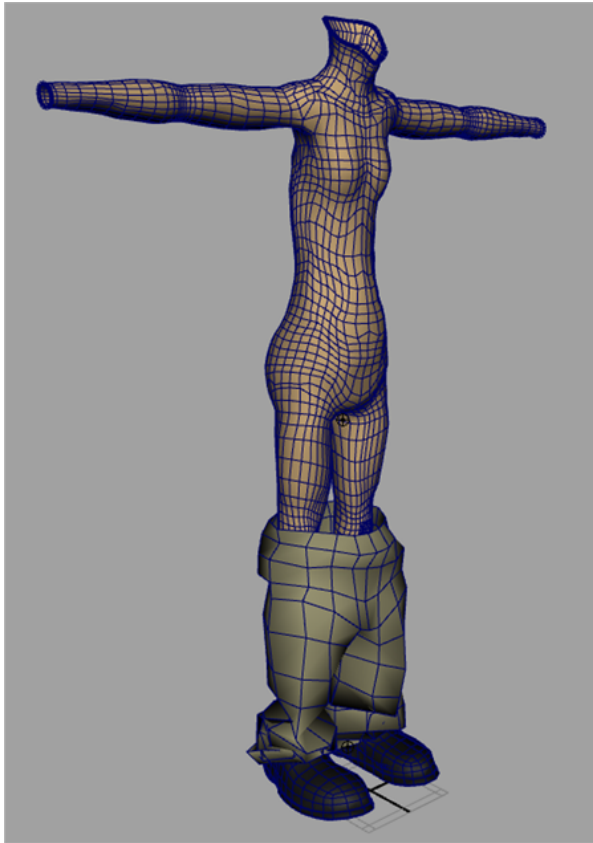
Lesson setup

To ensure the lesson works as described, do these steps before beginning:

- 1 If you have not already done so, download the nCloth Advanced Techniques Lesson Data from the following location: <http://www.autodesk.com/maya-advancedtechniques>. Then, set the nClothAdvancedTutorials directory as your Maya project.
- 2 Open the scene file named `Character_LowRes_2.mb`. This file can be found in the nClothAdvancedTutorials directory that you set as your Maya project.

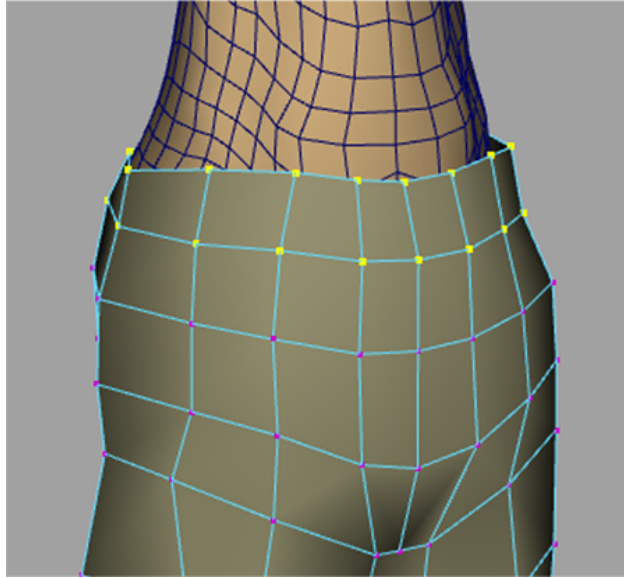
Constrain the pants to the body

When you play back the simulation, you notice that the nCloth pants are now colliding with the body and shoe objects, but they are falling off the character's body. To keep the pants from falling, create a **Point to Surface** constraint to constrain the nCloth pants object to the nRigid_Body object's waist area. For more information about nConstraints, see *Constraining Nucleus objects* on the *nDynamics* guide.



To constrain the pants to the character's body

- 1 In the scene view, select the nCloth pants object.
- 2 Right-click the nCloth and select **Vertex** from the marking menu that appears.
- 3 Select the first two rows of vertices at the top of the nCloth pants.
Dolly and tumble the camera to ensure that only those vertices in the first two rows are selected.



- 4 In the scene view, Shift-select the nRigid_Body object and select **nConstraint > Point to Surface**.

For this lesson, leave the **dynamicConstraintShape** attributes at their default values.

Edit the pants' Dynamic Properties attributes

When you play back the simulation, you notice the following:

- The nCloth pants simulate using the default **Dynamic Properties** settings. This behavior might not resemble the type of material suitable for the character's clothing.
- The nCloth pants come to rest state after 40 frames of the simulation (frame 1040).

When simulating nCloth on a character that is standing still, edits to the nCloth's **Dynamic Properties** attributes may only produce subtle changes to the cloth's behavior since gravity and wind are the only forces working on the nCloth. When the nCloth is simulated on an animated character, changes in the cloth's behavior will be more noticeable as these forces begin to generate velocity, collisions, and self collisions, causing your nCloth to deform in different areas and in different directions. Therefore, to simplify your simulation set up, you can give your nCloth some of its unique characteristics by editing some **Dynamic Properties** attributes using a static simulation.

Stretch Resistance and **Compression Resistance** are important attributes in determining the nature of your cloth. These properties iterate resistance on the links and cross links on each quad of the nCloth mesh. **Stretch Resistance** works to stabilize the pulling or stretching effect which results from the Nucleus forces, such as gravity and wind. **Compression Resistance** works to stabilize the compressing or squeezing effects on the links as a result of Nucleus forces.

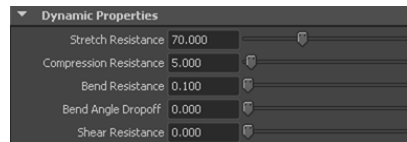
For example, to create nCloth that behaves like heavy denim, burlap, or thick leather, higher **Stretch Resistance** values are required, while lighter materials, such as silk or cotton, use lower **Stretch Resistance**.

The higher you set these two attributes, the more the nCloth resists deformation, although they tend to increase simulation time. For more information about **Stretch Resistance** and **Compression Resistance**, see *Stretch Resistance* and *Compression Resistance* in the *nDynamics* guide.

Be aware that adjusting one **Dynamic Properties** attribute can affect other attributes. For example, increasing your nCloth's **Mass** makes it heavier, which may require an increase in **Stretch Resistance** to compensate. A useful method for editing your nCloth's **Dynamic Properties** attributes is to set one attribute at a time, and then playback the simulation to observe how the adjustment affects your nCloth.

To edit Stretch Resistance and Compression Resistance

- 1 In the **Attribute Editor**, select the **nCloth_PantsShape** tab.
- 2 In the **Dynamic Properties** section, set **Stretch Resistance** to 70.
- 3 Set **Compression Resistance** to 5.

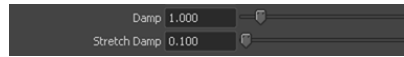


- 4 Playback the simulation.

When you playback the simulation, notice that the nCloth pants still come to a rest state after 40 frames of simulation. Increasing **Damp** can bring your simulated nCloth to rest sooner as it dissipates the energy generated from your nCloth **Stretch Resistance** working against the pull of the Nucleus **Gravity**. You can also use **Stretch Damp** to dissipate this energy.

To edit Damp

- 1 In the **Attribute Editor**, select the **nCloth_PantsShape** tab.
- 2 In the **Dynamic Properties** section, set **Damp** to 1.



- 3 Play back the simulation.

Other attribute settings to consider

Before proceeding with your simulation, consider adjusting the collision **Thickness** attribute for each nCloth and passive collision object to optimize the collision detection between them. When using a workflow that includes a wrap deformer, you will want to ensure that the nCloth collision volume (**Thickness**) allows room for the wrapped mesh without causing interpenetrations with the nRigid_Body and nRigid_Shoes objects.

Lesson 3: Wrapping the high resolution mesh and simulating the pants during animation

In this lesson you will:

- Create a wrap deformer to influence the behavior of the high resolution mesh (Pants_HighRes).
- Import geometry caches to animate the body (nRigid_Body) and shoe (nRigid_Shoes) meshes.
- Create an nCache for the simulated nCloth pants object.
- Identify problem areas in the simulation, such as poorly deformed polygons and interpenetrations caused by inaccurate collision detection between the nCloth and passive collision objects or self collisions within the nCloth itself.
- Edit Nucleus solver **Substeps** to improve the overall quality of the simulation.
- Set keyframes to increase Substeps at specific problem frames in the simulation.
- Resolve interpenetrations.

Lesson setup

To ensure the lesson works as described, do these steps before beginning:

- 1 If you have not already done so, download the nCloth Advanced Techniques Lesson Data from the following location: <http://www.autodesk.com/maya-advancedtechniques>. Then, set the `nClothAdvancedTutorials` directory as your Maya project.

For this lesson, you need to access Maya geometry cache files in addition to the lesson scene file.

- 2 Open the scene file named `Character_LowRes_3.mb`.

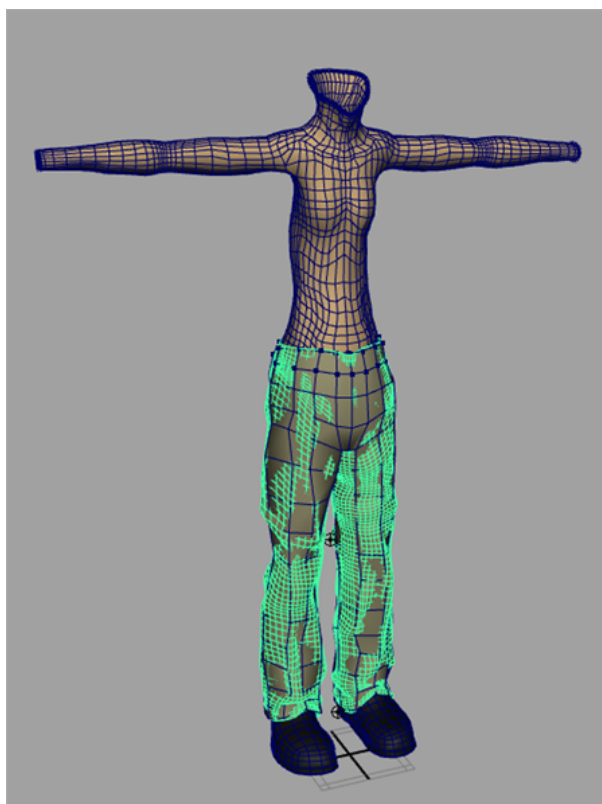
This file can be found in the `nClothAdvancedTutorials` directory that you set as your Maya project.

Wrapping the high resolution mesh

In this lesson, you use a wrap deformer to create an influence object that causes the high resolution mesh to behave like the simulated low resolution mesh. For more information about the wrap deformer, see *What are deformers?* in the *Rigging* guide.

To wrap the high resolution mesh

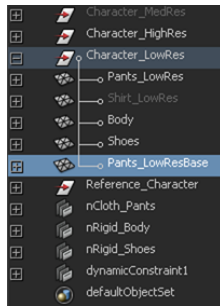
- 1 In the **Outliner**, expand `Character_HighRes`, and show the `Pants_HighRes` object by selecting it, and then selecting **Display > Show > Show Selection**.



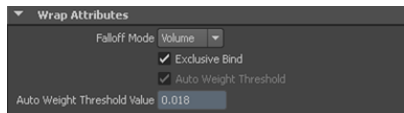
- 2 Shift-select the nCloth pants.
- 3 From the Animation menu set, select **Create Deformers > Wrap**. A wrap node appears in the **Attribute Editor**, and in the **Outliner**, you can see that the *Pants_LowResBase* object has been added to the *Character_LowRes* group.

NOTE

You may need to expand *Character_LowRes* to see the *Pant_LowResBase* object in the **Outliner**.



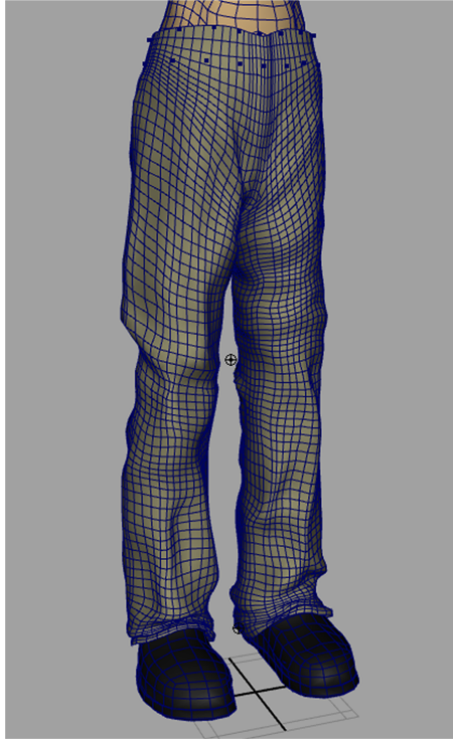
- 4 In the **Attribute Editor**, click the **wrap1** tab.
- 5 In the **Wrap Attributes** section, turn on **Exclusive Bind**.



With **Exclusive Bind** turned on, each surface point (vertex) on the Pants_HighRes object is constrained or affected by the Pants_LowRes object vertices. This ensures that the Pants_HighRes object inherits the properties of the simulated nCloth pants.

- 6 **Hide** the Pants_LowRes object, and play back the simulation.

When you play back the simulation, you notice the following:



- The Pants_HighRes object appears to be simulating as if it were an nCloth object.
- The speed of the resolution is not reduced or affected by the Pants_HighRes object.

With the high polygon count of the Pants_HighRes object, one would expect to see the simulation slow down. However, this is not the case, since the Nucleus solver is not simulating any data associated with the Pants_HighRes object. All Nucleus calculations involved in the simulation are still performed on the low resolution nCloth pants. The behavior of the Pants_HighRes object is being influenced by a new instance of the simulated nCloth pants, the Pants_LowResBase object.

The Pants_LowResBase object is the base shape for the deformation of the Pants_HighRes object, which is the wrap influence object. Like all wrap deformer, any difference in position, orientation, or shape between the base shape and the wrap influence object results in a deformation of the surface being influenced by the wrap deformer.

Simulating the nCloth pants on an animated character

In this section, you import geometry caches for the nRigid body and nRigid shoe objects and begin simulating the nCloth pants object while the body and shoes are animated.

Lesson setup

To ensure that this section of the lesson works as described, do these steps before beginning:

- 1 Hide the `Pants_HighRes` object by selecting `Pants_HighRes` in the **Outliner**, and selecting **Display > Hide > Hide Selection**.
- 2 Show the `Pants_LowRes` object by selecting `Pants_LowRes` in the **Outliner**, and selecting **Display > Show > Show Selection**.
- 3 If you have not already done so, set the nCloth `nClothAdvancedTutorials` directory as your Maya project.

Importing geometry caches

Before simulating the nCloth pants on the animated character, you need to import the geometry caches which animate the character's body and shoes.


To import the geometry caches to animate the body and shoe meshes

- 1 In the scene view, select the `Body` object.
- 2 From the **Animation** menu set, select **Geometry Cache > Import Cache**.
- 3 In the **Import Cache File** window that appears, do the following:
 - From the **Files of type list**, select **All Files**.
 - From the list of cache files, select `Body_Animation.mc`.
 - Click **Open**.
- 4 In the scene view, select the `Shoes` object and follow the instructions in step 3. Instead of `Body_Animation.mc`, select `Shoes_Animation.mc` from list of cache files.

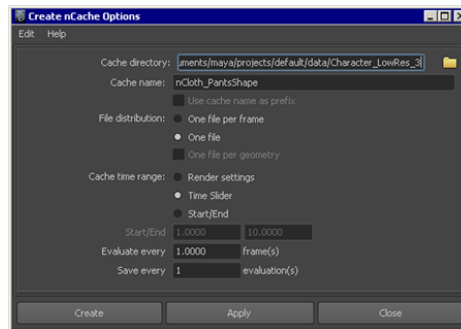
You can play back the simulation to see how your nCloth pants behave when they are simulated with the animated character. However, it is difficult to closely inspect the simulation without being able to scrub the **Time Slider**. To make it easier to identify problems in the simulation, create a cache for

the nCloth pants object. For information about nCaches, see *nCaching overview* in the *nDynamics* guide.

To cache the nCloth pants simulation

- 1 In the scene view, select the nCloth pants.
- 2 From the **nDynamics** menu set, select **nCache > Create New Cache > **.

The **Create nCache Options** window appears.

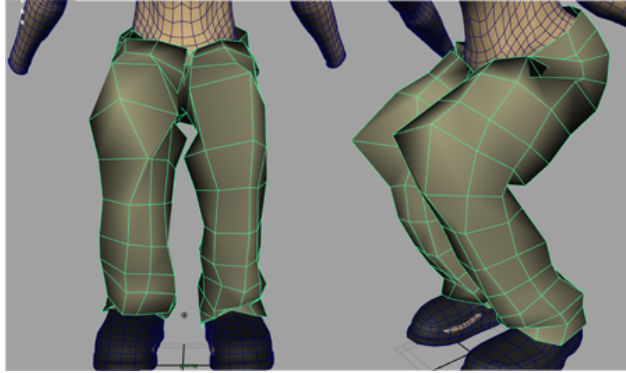


- 3 In the **Create nCache Options** window, do the following:
 - Set the **Cache directory** to the folder where you want your caches saved.
 - Set the **Cache Name** to nCloth_PantsShape.
 - Beside **File distribution**, select **One File**.
 - Click **Create**.
- 4 Play back the simulation.

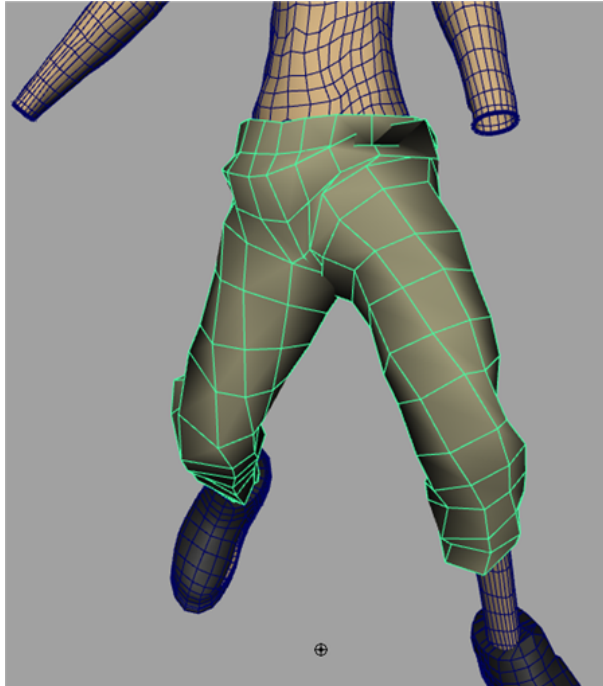
Identifying problem areas in the simulated nCloth

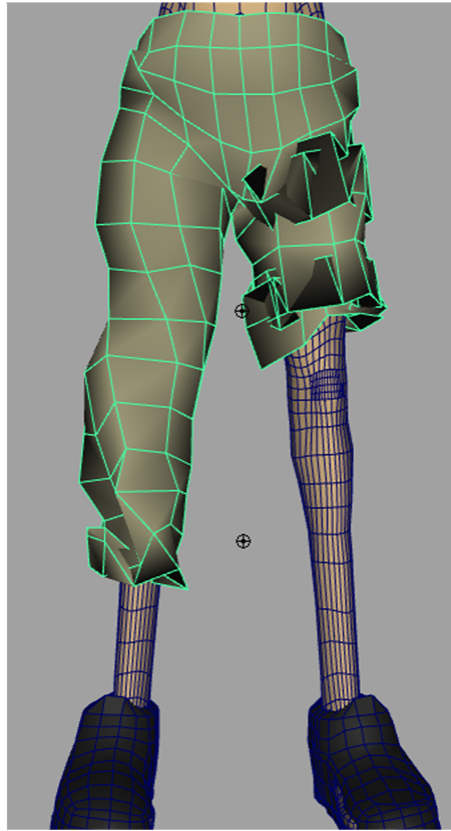
When you play back the simulation, you notice the following problems with the nCloth pants object:

- Between frames 1025 and 1035, the polygon faces around the waist and crotch area of the pants are exhibiting poor self collisions, resulting in interpenetrations. Also, the polygon faces in the front and back of the knees are poorly formed, with some polygons protruding outward making the cloth look heavy and stiff.



- At frame 1037, the polygon faces around the ankle area are folding over each other and are becoming trapped.
- Between frames 1040 and 1045, self collision issues continue at the waist, knees, and cuff of the pants.





Dolly and tumble the scene while scrubbing the **Time Slider** so that you can closely observe each problem area.

Editing Substeps

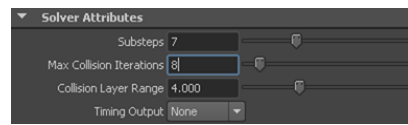
A useful first step to fixing simulation issues is to increase the number of Nucleus solver **Substeps** and **Max Collision Iterations**. **Substeps** specify the number of times per frame that the Maya Nucleus solver calculates everything involved in the simulation, from the collision detection between nCloth and passive collision objects, to the effects of **Dynamic Properties** attributes and the dynamic constraints. Adjusting **Substeps** allows you to control how the simulation time is broken up into calculation segments. Simulation quality and collision accuracy generally improve with increasing substeps values. **Max Collision Iterations** specify the maximum number

of collision iterations per frame for this Maya Nucleus solver. A high number of **Substeps** or **Max Collision Iterations** may result in slower solving.

Depending on the complexity of your scene, the default values of 3 **Substeps** and 4 **Max Collision Iterations** may work well when simulating a static scene in which only gravity and wind are affecting the nCloth objects. When the nCloth begins to move and self collide, higher **Substeps** values are required to ensure accurate collision detection, especially on fast-moving objects. Increasing **Max Collision Iterations** becomes important when the number of nCloth collisions increases, and when dynamic constraints are added to your object. For more information, see *Substeps* and *Max Collision Iterations* in the *nDynamics* guide.

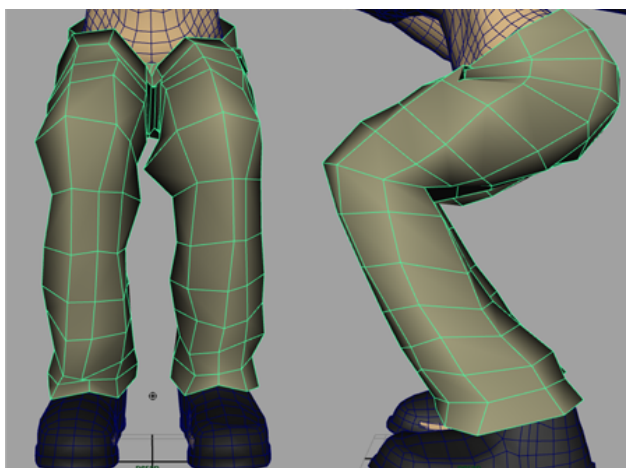
To edit Substeps and Max Collision Iterations

- 1 In the **Attribute Editor**, click the **nucleus1** tab.
- 2 In the **Solver Attributes** do the following:
 - Set **Substeps** to 7.
 - Set **Max Collision Iterations** to 8.



- 3 Before playing back the simulation to see the results of these new settings, you need to replace the simulation's previous nCache or create a new nCache. Otherwise, your changes will not appear in the simulation.
Replacing a cache file overwrites the existing nCache with a new file. Since you will cache your simulation a number of times in the lesson, using **Replace Cache** is the best way to reduce the number of cache files saved to your hard disk. To replace the previous nCache, select **nCache > Replace Cache**.
- 4 When the **Create Cache Warning** appears, click **Replace Existing**.
- 5 Play back the simulation.

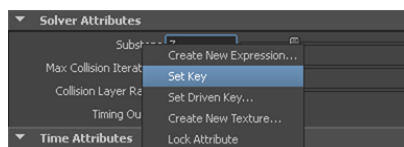
When you play back the simulation, you notice that starting at frame 1030, the polygon faces in the area of the knees look more realistic. The cloth deformation is now spread over more faces, making it look more realistic. However, not all of the simulation problems were resolved. Higher **Substeps** and **Max Collision Iterations** may be required.



Because increasing **Substeps** and **Max Collision Iterations** cause the Nucleus solver to perform more calculations each simulated step, it slows down the simulation. To develop a balance between simulation quality and performance, it is useful to identify the specific areas or frames in the simulation that require higher **Substeps** and **Max Collision Iterations**. You can then animate the **Substeps** and **Max Collision Iteration** values over the duration of the simulation by setting keyframes.

To set keyframes for Substeps and Max Collision Iterations

- 1 In the **Time Slider**, go to frame 1000.
- 2 In the **Attribute Editor**, select the **nucleus1** tab.
- 3 In the **Solver Attributes** section, do the following:
 - Set **Substeps** to 5.
 - Right-click the **Substeps** attribute field, and select **Set Key** from the pop-up menu.



- Set **Max Collision Iterations** to 6
- Right-click the **Max Collision Iterations** attribute field, and select **Set Key** from the pop-up menu.

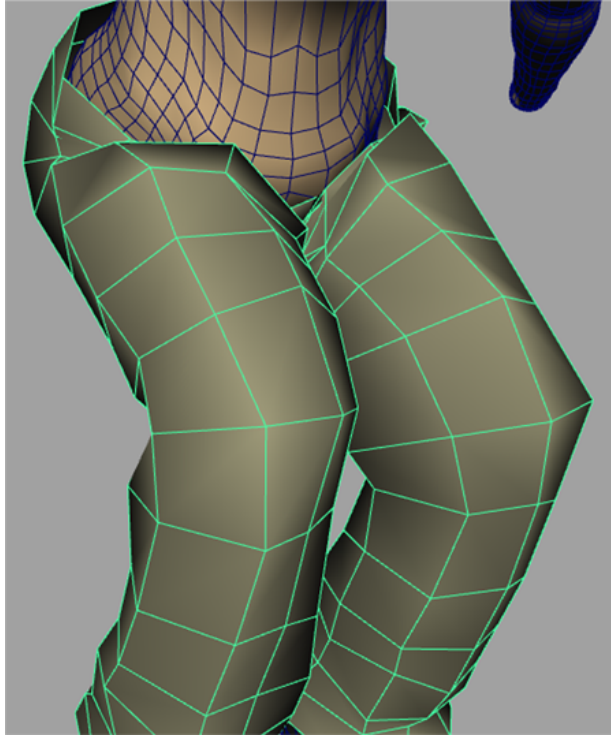
- 4 Continue setting keyframes in your simulation using values from the following table:

Frame	Substeps	Max Collision Iterations
1019	5	6
1020	7	8
1022	9	12
1025	15	20
1060	9	12

- 5 Cache your simulation (**nCache > Replace Cache**) and play it back.

Fine tuning nCloth attributes

When you play back the cache, you notice that the overall quality of the simulation has improved. However, there are still problem areas in the waist and in the crotch. For example, at frame 1030, poor self collisions in the area of the crotch are resulting in undesirable polygon deformations. To improve the quality your simulation, you can start to fine tune the **Dynamic Properties** attributes.



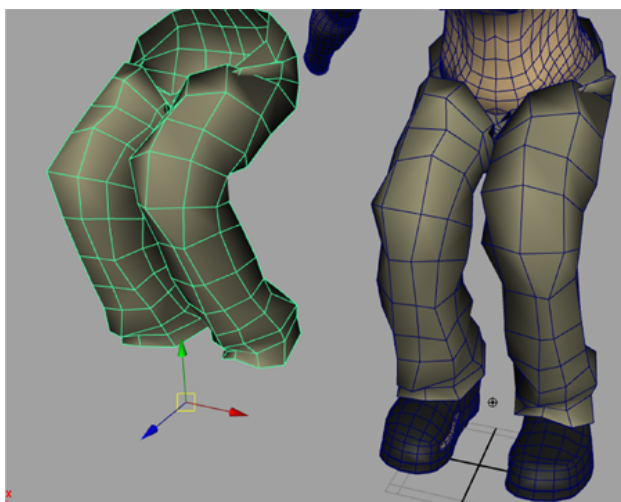
When fine adjusting nCloth attributes, such as the **Dynamic Properties** attributes, it is useful to create a duplicate of the nCloth mesh at different frames of your simulation. When you play back the simulation, you can then compare your currently simulated nCloth against the duplicate mesh and evaluate:

- If you have correctly identified the attribute that requires adjustment.
- How the adjustment affects the nCloth behavior.

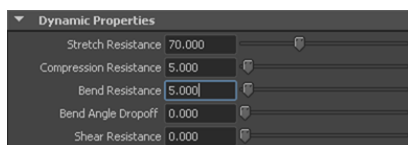
To help solve the problems in the crotch area, you can increase **Bend Resistance** so that the edges of the polygons better retain their shape. For more information, see *Bend Resistance* in the *nDynamics* guide.

To create a duplicate mesh and edit Bend Resistance

- 1 In the **Time Slider**, go to frame 1030.
- 2 In the scene view, select the nCloth pants and select **Edit > Duplicate**.
- 3 In the **Outliner**, select *Pants_LowRes1* and in the scene view, move the mesh object to the right of your character.

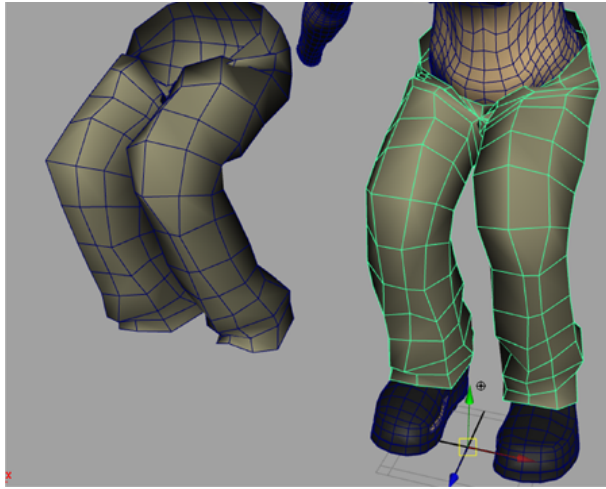


- 4 In scene view, select the original nCloth pants object, and in the **Attribute Editor**, click the **nCloth_PantsShape** tab.
- 5 In the **Dynamics Properties** section, set **Bend Resistance** to 5.



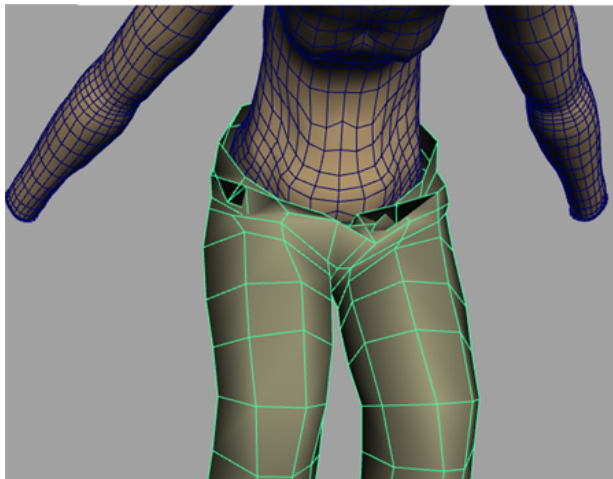
- 6 Cache the simulation (**nCache** > **Replace Cache**) and play it back.

When you play back the simulation, you notice that the cloth is bending more realistically in the crotch area. In the **Time Slider** go to frame 1030, and compare your simulated nCloth to the duplicate mesh. Dolly and tumble the scene so that you can closely observe the improved area.



Editing Quality Settings and resolving interpenetrations

When you play back the simulation and compare the problem areas with duplicate meshes, you notice that the problem areas between frame 1030 and 1035 still persist.



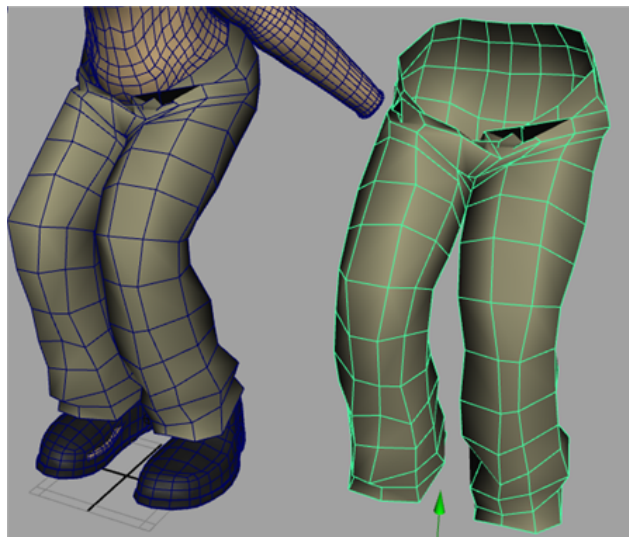
Another way to improve simulation quality is to edit the **Self Collision Flag** and **Quality Settings** attributes, which affect the nCloth component collisions and self collisions. By default, **Self Collision Flag** is set to **VertexFace**, which means that the nCloth object's vertices and faces collide

with each other. Setting **Self Collision Flag** to **Full Surface** sets all of the object components (vertices, edges, and faces) to participate in self collisions.

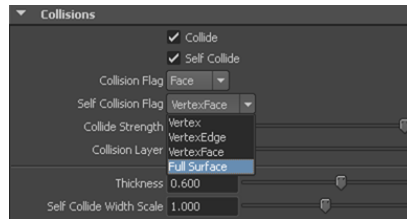
When simulating a low resolution mesh, increasing the number of potential self collision areas of the nCloth object is important because of the mesh's low vertex, edge, and face count. Setting **Self Collision Flag** to **Full Surface** on high resolution nCloth meshes increases simulation time. This is less of an issue with low resolution meshes, which makes this alternative much more appealing for iterative simulation tests. For more information, see *Collisions* in the *nDynamics* guide.

To edit the Self Collision Flag attribute

- 1 In the **Time Slider**, go to frame 1033.
- 2 In the scene view, select the nCloth pants and select **Edit > Duplicate**.
- 3 In the **Outliner**, select *Pants_LowRes2* and in the scene view, move the mesh object to the left of your character.



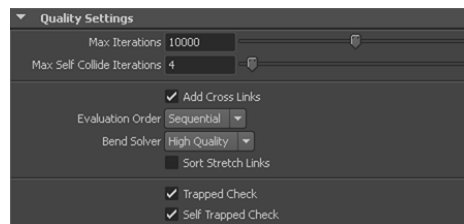
- 4 In scene view, select the original nCloth pants object, and in the **Attribute Editor**, click the **nCloth_PantsShape** tab.
- 5 In the **Collisions** section, set **Self Collision Flag** to **Full Surface**.



After initial fine adjustments to the **Self Collision** attribute, you edit the **Quality Settings** to improve collisions and self collisions in the simulation. This will resolve any remaining interpenetrations between the nCloth pants object and the nRigid shoes. You can also increase **Thickness** or create a **Thickness Map** to improve collision detection.

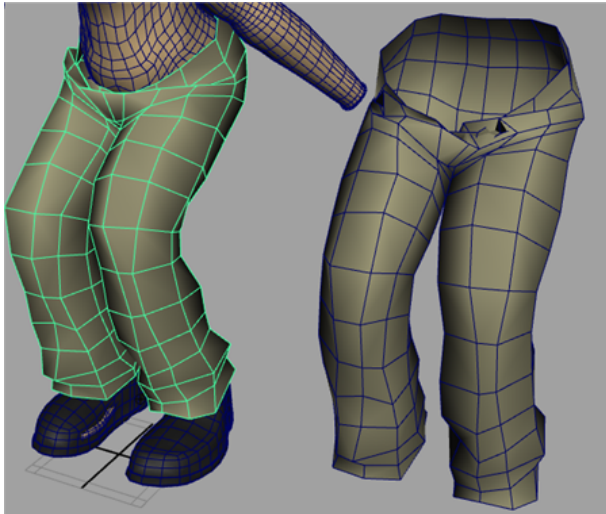
To edit the Quality Settings

- 1 In the **Attribute Editor**, select the **nCloth_PantsShape** tab.
- 2 In the **Quality Settings** section, do the following:
 - Make sure **Max Iterations** is set to 10000.
 - Turn on **Trapped Check**.
 - Turn on **Self Trapped Check**.



- 3 Cache the simulation and then play it back.

In the **Time Slider**, go to frame 1033, and compare your simulated nCloth to the duplicate mesh. Dolly and tumble the scene so that you can closely observe the problem area. When you are satisfied with your observations, delete the *Pants_LowRes1* and *Pants_LowRes2* duplicate meshes.



Comparing the wrapped nCloth simulation with the simulated high resolution mesh

To complete the attribute adjustments of the nCloth pants object, you compare the wrapped nCloth simulation to the reference character object (the original simulated high resolution mesh).

To compare the low and high resolution nCloth meshes

- 1 Hide the Pants_LowRes object, selecting it in the **Outliner**, and then selecting **Display > Hide > Hide Selection**.
- 2 Show the Pants_HighRes object by selecting it in the **Outliner**, and then selecting **Display > Show > Show Selection**.
- 3 Using the Display Layer editor, turn on Visible to display the Reference_Character object in the scene view.
- 4 Hide the Reference_Shirt object, selecting it in the **Outliner**, and then selecting **Display > Hide > Hide Selection**.
- 5 In the **Shading** menu, turn off **Wireframe on Shaded**.
- 6 Scrub through the **Time Slider** to compare how the nCloth meshes behave in the animation. Dolly and tumble the scene so that you can closely observe the problem area.

NOTE


If the Reference_Character is not animated in the scene view when you play back or scrub the simulation, you may need to reconnect the reference character's caches to their respective objects. See [Reconnecting objects to existing caches](#) (page 35).



Reconnecting objects to existing caches

- 1 In the **Outliner**, select the object whose cache you want to reconnect.
- 2 In **Attribute Editor**, select the object's cache node.

For example, if you are reconnecting the cache for the character's body, select the **Body_AnimationCache1** tab.

- 3 In the **Cache File** section, make sure that **Base Directory** is set to the `nClothAdvancedTutorials` project data folder by clicking the  icon.
- 4 In the **Assign Cache Directory** window, click **Open**.

Observations

When you play back or scrub the simulation, you notice the following:

- Overall, the wrapped nCloth pants and reference character objects behave in the same way.
- Between frames 1040 and 1047, the pant legs on nCloth pants object are falling a little faster than the pant legs on the reference character object.

TIP

To force the pant legs of the nCloth pants to simulate in the same way as the pant legs on the reference character object, you can adjust the **Friction** attribute.

Lesson 4: Simulating the low resolution shirt

In this lesson, you simulate the character's shirt using the workflow described in Lesson 3. Although there are some variations in attributes and values, the principles are the same.

In this lesson you will:

- Convert the `Shirt_LowRes` object to nCloth.
- Create a wrap deformer to influence the behavior of the high resolution mesh (`Shirt_HighRes`).
- Apply the nCloth **tshirt** preset to the nCloth shirt.
- Edit the nCloth shirt **Dynamic Properties** attributes.
- Create an nCache for the nCloth shirt.
- Identify problem areas in the simulation, such as poorly deformed polygons or interpenetrations.
- Edit the nCloth shirt Quality Settings.
- Resolve interpenetrations.

Lesson Setup

To ensure the lesson works as described, do these steps before beginning:


- 1 If you have not already done so, download the nCloth Advanced Techniques Lesson Data from the following location: <http://www.autodesk.com/maya-advancedtechniques>. Then, set the nClothAdvancedTutorials directory as your Maya project.
For this lesson, you need to access Maya geometry cache files in addition to the lesson scene file.
- 2 Open the scene file named `Character_LowRes_4.mb`.
This file can be found in the nClothAdvancedTutorials directory that you set as your Maya project.
- 3 Import the geometry caches which animate the character's body and shoes. See [Importing geometry caches](#) (page 22).
- 4 To speed up the simulation of the nCloth shirt, either create a new cache for the nCloth pants, or use the pants nCache from the previous lesson.
To create a new nCache, in the **Outliner** select `nCloth_Pants`, and select **nCache > Create New Cache**.
To use the nCloth pants nCache from the previous lesson, you may need to reconnect the cache to the nCloth object. See [Reconnecting objects to existing caches](#) (page 35).

If you use a Maya scene file from a previous lesson, ensure that you:

- Turn off the visibility for the Reference_Character object in the Display Layer editor.
- Hide the Pants_HighRes object.

Converting the shirt to nCloth

To convert the shirt to nCloth

- 1 Show the Shirt_LowRes object by selecting it in the **Outliner**, and then selecting **Display > Show > Show Selection**.
- 2 Select the low resolution shirt object (Shirt_LowRes) and select **nMesh > Create nCloth > **.
The **Create nCloth Options** window appears.
- 3 From the **Solver** drop down list, ensure nucleus1 is selected.
- 4 Click **Create Cloth**.

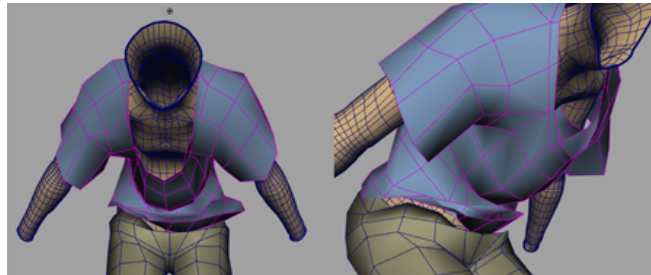
The low resolution shirt is converted to an nCloth object, and is added to the existing Maya Nucleus solver.

- 5 To ensure that the low resolution nCloth shirt is easy to identify in your scene, rename it. To do this, in the **Outliner**, double-click *nCloth1*, type *nCloth_Shirt*, then press Enter.
- 6 Cache the nCloth shirt simulation by selecting *nCloth_Shirt* in the **Outliner** and selecting **nCache > Create New Cache**.
- 7 Play back the simulation.

Applying an nCloth preset to the shirt

When you play back the simulation, you notice the following:

- Around frame 1033, the shirt collar is stretching too much to resemble the fabric it's trying to emulate.
- At frame 1033, some of the shirt's vertices are self trapped within the object, and interpenetrations between the shirt and pants appear around the character's waist. This is caused by inaccurate collisions between the nCloth shirt and nCloth pants objects.



- At frame 1037, the polygon faces in the front of the shirt are deforming poorly.
- Between frames 1040 and 1045, some of the shirt's vertices are trapped by the nCloth pants, and there are interpenetrations.

A useful way to solve a number of these simulation problems simultaneously is to apply an nCloth attribute preset to the nCloth shirt object.

To apply an nCloth preset to the shirt

- 1 In the scene view, select the nCloth shirt.
- 2 In the **Attribute Editor**, select the **nCloth_ShirtShape** tab.

- 3 Click-hold the **Presets** button.
- 4 Select the **tshirt** preset, and then **Replace (tshirt > Replace)**.

Some important attribute adjustments made by the t-shirt preset are the following:


- **Stretch Resistance** is adjusted from 20 to 35.
- **Bend Angle Dropoff** is adjusted from 0 to 0.4.
Bend Angle Dropoff adds resistance to bending forces by responding to the angle and strength of the force applied to the nCloth. For example, a high **Bend Angle Dropoff** causes an nCloth to resist bending at higher angles more than at lower angles. When you simulate the shirt, you will see **Bend Angle Dropoff** reducing the nCloth's tendency to bend when the it is beginning to bundle up at frame 1032.
- **Mass** is adjusted from 1.0 to 0.6.
The reduction in **Mass** reflects the light-to medium-weight material of a cotton t-shirt.
- **Damp** is adjusted from 0.0 to 0.8.

Cache the simulation by selecting the nCloth shirt and selecting **nCache > Replace Cache** and then play it back to observe the results.

Wrapping the high resolution mesh

In this section of the lesson, you use a wrap deformer to create an influence object for the high resolution shirt.

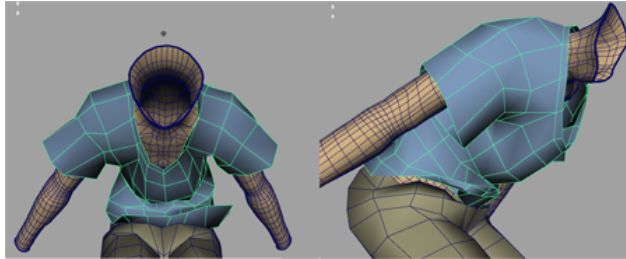
To wrap the high resolution mesh

- 1 Show the Shirt_HighRes object by selecting it in the **Outliner**, and then selecting **Display > Show > Show Selection**.
- 2 In the scene view, Shift-select the nCloth shirt object.
- 3 From the Animation menu set, select **Create Deformers > Wrap** .
.
- 4 In the **Create Wrap Options** window, turn on **Exclusive Bind**.
- 5 Click **Create**.
A wrap node appears in the **Attribute Editor**, and a Shirt_LowResBase object appears in the **Outliner**.
- 6 **Hide** the Shirt_HighRes object.

Identifying problem areas in the simulated nCloth

When you play back the simulation, you notice the following:

- At frame 1032, the excessive stretching around the shirt's collar is reduced. However, this area of the nCloth is still stretching too much.



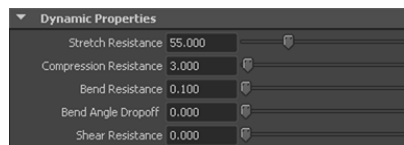
- At frame 1033, in the waist area, some previous instances of self trapped vertices have been resolved, however some interpenetrations still remain.

The nCloth t-shirt preset has improved many of the simulation issues, however some **Dynamic Properties** attributes need further adjustment.

When editing the **Dynamic Properties** attributes, cache your simulation and then play it back between attribute adjustments to see how your new settings affect the nCloth shirt's behavior. For comparison purposes, you can also display the reference character in the scene. To do this, in the Display Layer Editor, turn on Visible.

To edit the shirt's Dynamic Properties

- 1 In the **Attribute Editor**, click the **nCloth_ShirtShape** tab.
- 2 In the **Dynamic Properties** section, make the following settings:
 - **Stretch Resistance:** 55
 - **Compression Resistance:** 3
 - **Bend Resistance:** 0.3

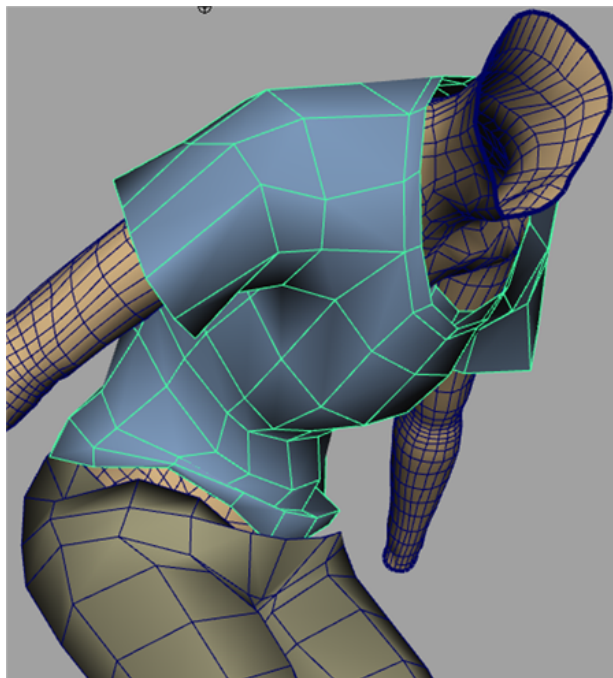


- 3 Cache your simulation, and play it back.

Editing the Quality Settings and resolving interpenetrations

When you play back the simulation, you notice the following:

- Between frames 1028 and 1034, around the character's waist, there are areas where the pants and shirt no longer overlap. Also, at the character's back there is still some of the shirt's vertices trapped by the pants.



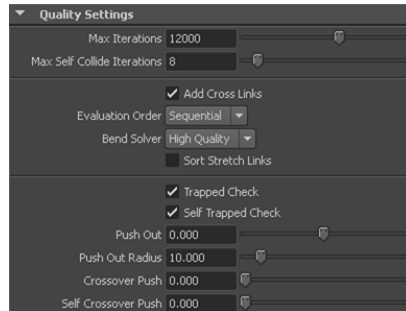
The offset between the nCloth object occurs because the collision **Thickness** is currently set to accommodate the high resolution wrap deformer. Reducing **Thickness** may solve this issue, but be aware that interpenetrations can result from such an adjustment. For the purposes of this tutorial, **Thickness** is left at its present value.

To smooth the mesh and reduce instances of interpenetrations, edit the **Quality Settings**.

To edit the Quality Settings

- 1 In the **Attribute Editor**, select the **nCloth_ShirtShape** tab.
- 2 In the **Quality Settings** section, set the following:
 - **Max Iterations**: 12000.

- **Max Self Collision Iterations: 8.**
- Turn on **Trapped Check.**
- Turn on **Self Trapped Check.**



3 Cache the simulation (**nCache > Replace Cache**) and play it back.

Fine tuning the simulation

To further improve the quality of the simulation and reduce the instances of interpenetration in problem areas, such as the bunching of the shirt in the chest area (see frame 1040) you can set **Push Out** and **Push Out Radius**. Try setting the attributes values between the following ranges:

- **Push Out:** 0.1—20
- **Push Out Radius:** 10—50

Experiment with your settings by creating duplicates of the meshes at specific frames of the simulation. For example, create mesh duplicates at frames 1040 and 1043. Cache the simulation, and then scrub through the **Time Slider** and compare your simulation with your duplicate mesh to see the results of your attribute edits.

Comparing the final low resolution simulation with the simulated reference character mesh

In this lesson, you compare the final simulation result of the nCloth shirt and nCloth pants objects with the simulated reference character object (the original simulated high resolution mesh).

To compare the simulations

- 1 Hide the Shirt_LowRes and Pants_LowRes objects, selecting by selecting them in the **Outliner**, and then selecting **Display > Hide > Hide Selection**.
- 2 Show the Shirt_HighRes and the Pants_HighRes objects by selecting them in the **Outliner**, and then selecting **Display > Show > Show Selection**.
- 3 Using the Display Layer editor, turn on Visible to display the Reference_Character object.
- 4 In the **Shading** menu, turn off **Wireframe on Shaded**.
- 5 Scrub through the **Timeline**, to compare how the nCloth meshes behave in the animation. Dolly and tumble the scene so that you can closely observe the problem areas.

NOTE

If the Reference_Character is not animated in the scene view when you play back or scrub the simulation, you may need to reconnect the reference character's caches to their respective objects. See [Reconnecting objects to existing caches](#) (page 35).





There are subtle differences in the way the high resolution and reference character objects simulate, but overall the nCloth behaves in similar ways. Considering the amount of time saved by repeatedly working through the simulation workflow of caching the simulation and adjusting attributes on the low resolution mesh, this workflow provides good results. Although the reference character object can be improved by optimizing the simulation, the higher resolution mesh slows down caching and simulation time and might require more attribute adjustments.

Lesson 5: Simulating medium resolution meshes using custom nCloth attribute presets

Now that you have used the workflow in Lessons 3 and 4 to realistically solve the low resolution nCloth meshes, you can use them to quickly prepare a medium resolution version of the nCloth pants and shirt for simulation.

In this lesson, you will:

- Save the nCloth attributes for the Shirt_LowRes and Pants_LowRes objects as custom nCloth presets.
- Change the **Scaling Relation** attribute and observe its impact on the nCloth simulated meshes.

Lesson Setup

- 1 If you have not already done so, download the nCloth Advanced Techniques Lesson Data from the following location: <http://www.autodesk.com/maya-advancedtechniques>. Then, set the nClothAdvancedTutorials directory as your Maya project.

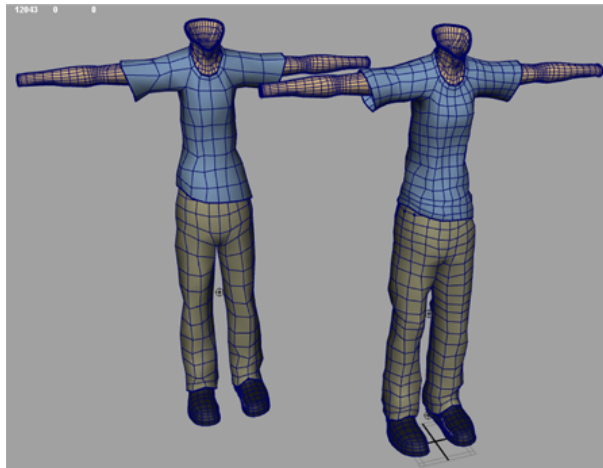
For this lesson, you need to access Maya geometry cache files in addition to the lesson scene file.

- 2 Open the scene file named `Character_MedRes.mb`.

This file can be found in the nClothAdvancedTutorials directory that you set as your Maya project.

The medium resolution shirt and pant meshes have already been converted to nCloth objects and named nCloth_Shirt_MedResShape and nCloth_Pants_MedResShape.

A **Point to Surface** constraint has been applied to the pants to constrain them to the character's waist. The medium resolution shirt and pants have already been wrapped (using a wrap deformer) with a new, duplicated high resolution shirt and pants mesh. The low resolution shirt and pants, and the nCloth shirt and nCloth pants objects have been cached and are positioned next to the medium resolution meshes for reference.



- 3 Import the geometry caches which animate the character's body and shoes for the low resolution and medium resolution characters. See [Importing geometry caches](#) (page 22).

Save the nCloth attributes as custom presets

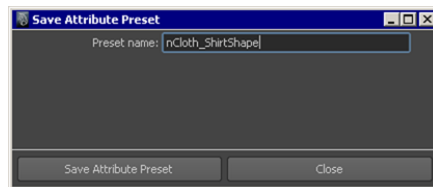
By the end of Lesson 3 and 4, you generated optimized simulations of your character's shirt and pants. A number of steps were involved in obtaining the attribute values that drive the behavior of these nCloth objects, and so you may want to save these optimized attribute values.

Using Maya attribute presets, you can save the attribute values of the low resolution nCloth shirt (nCloth_ShirtShape) and nCloth pants (nCloth_PantsShape) objects as custom nCloth presets. Your new nCloth presets can then be applied to other versions of the meshes, including the medium resolution shirt and pants. This workflow allows you to quickly prepare other simulations with geometry that has similar topology to your original objects.

To save the nCloth shirt object's attributes as a custom nCloth preset

- 1 In the scene view, select the low resolution nCloth shirt.
- 2 In the **Attribute Editor**, click the **nCloth_ShirtShape** tab.
- 3 Click-hold the **Presets** button.
The nCloth attribute **Presets** pop-up menu appears.
- 4 Select **Save nCloth Preset**.

The **Save Attribute Preset** window appears.

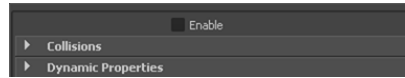


- 5 In the **Preset name** field type *nCloth_ShirtShape* for the name of the custom attribute preset you want to create, and then click **Save Attribute Preset**.
- 6 Repeat steps 1 to 5 to save the nCloth pants as a custom nCloth attribute preset *nCloth_PantsShape*.

Since you no longer need to simulate the low resolution nCloth shirt and pants, you can disable them from the Nucleus solver. Doing this increases the simulation speed of your medium resolution nCloth shirt and pants.

To disable the low resolution nCloth shirt and pants

- 1 In the scene view, select the low resolution nCloth shirt.
- 2 In the **Attribute Editor**, click the **nCloth_ShirtShape** tab.
- 3 Turn off **Enable**.



- 4 Repeat steps 1 to 3 for the nCloth pants object.
- 5 Hide the low resolution character and clothing by selecting *Character_LowRes* in the **Outliner** and then selecting **Display > Hide > Hide Selection**.

Applying the custom nCloth attribute preset to the medium resolution shirt and pants

In this lesson, you apply your custom nCloth attribute presets to the medium resolution versions of the nCloth shirt and pants (*nCloth_Shirt_MedResShape* and *nCloth_Pants_MedResShape*). After the attribute presets are applied, you can fine tune the simulation by adjusting the **Collisions**, **Dynamic Properties**, and **Quality Setting** attributes.

To apply your custom nCloth attribute preset to the medium resolution nCloth

- 1 In the scene view, select the nCloth medium resolution shirt.
- 2 In the **Attribute Editor**, click the **nCloth_Shirt_MedResShape** tab.
- 3 Click-hold the **Presets** button, select the **nCloth_ShirtShape** preset, and select **Replace**.
- 4 In the scene view, select the medium resolution nCloth pants.
- 5 In the **Attribute Editor**, click the **nCloth_Pants_MedResShape** tab select the **nCloth_PantsShape** preset, and select **Replace**.
- 6 In the scene view, Shift-select the medium resolution nCloth shirt and pants, and create a new cache for by selecting **nCache > Create New Cache**.

The nCloth shirt and pants simulations are saved in one nCache file.

- 7 Play back the simulation.

Comparing the final simulations

In the final sections of this lesson, you compare your final nCloth simulations. First, you compare the behavior of your medium resolution nCloth shirt and pant objects with your final low resolution shirt and pants simulations. This comparison allows you to see differences in the way the high resolution mesh behaves when it is wrapped on low and medium resolution meshes. In the last section, you compare all three simulation versions of nCloth (the original high resolution, medium resolution, and low resolution meshes).

To compare your medium and low resolution simulations

- 1 Hide the *Shirt_MedRes*, *Pants_MedRes*, *Shirt_LowRes*, and *Pants_LowRes* objects by selecting them in the **Outliner**, and then selecting **Display > Hide > Hide Selection**.
- 2 Show all the objects in the *Character_HighRes* group by selecting *Pants_HighRes* and *Shirt_HighRes* in the **Outliner**, and then selecting **Display > Show > Show Selection**.

The medium resolution and low resolution nCloth meshes, each wrapped by the same high resolution shirt and pants, now appear in the scene view.



- 3 Play back the scene.

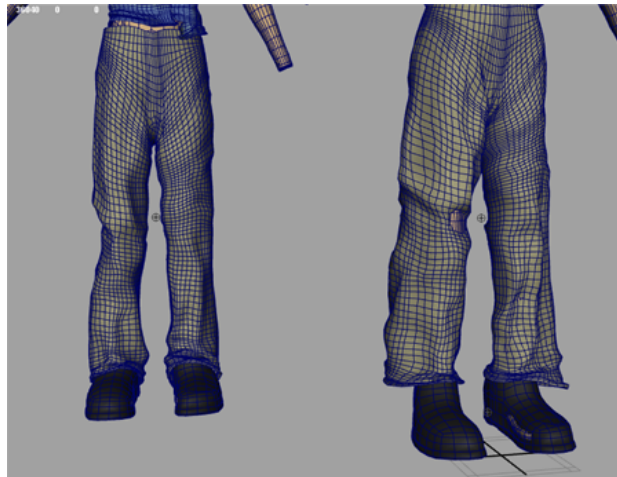
Dolly and tumble the scene while scrubbing the **Time Slider** so that you can closely observe any differences in the behavior of each nCloth object.

When you play back the simulations, you notice the following:

- The low and medium resolution shirts are behaving in the same way.
- The medium resolution pants are taking more time than the low resolution pants to settle in the first frames of the simulation.
- Between frame 1040 and 1045, the medium resolution pants ride further up on the character legs than the low resolution pants.



- At frame 1047, the cuffs of the medium resolution pants are further apart than the cuffs of the low resolution pants.



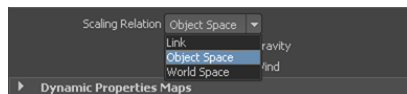
- The medium resolution pants appear to have more bounce during specific areas of the simulation.

If you are not satisfied with the behavior of your medium resolution nCloth shirt and pants, use the same attribute optimizing workflow described in Lessons 3 and 4 to adjust the **Collisions**, **Dynamic Properties**, and **Quality Settings** attributes.

You can remove some of the bounce from the medium resolution nCloth pants by editing the **Scaling Relation** attribute. When **Scaling Relation** is set to **Link**, the nCloth's dynamic attributes, such as **Bend Resistance** and **Stretch Resistance** are calculated relative to the mesh's scale. When **Scaling Relation** is set to **Object**, the dynamic attribute calculations are automatically scaled based on the mesh's resolution. Low resolution meshes tend to stretch more when **Scaling Relation** is set to **Object** rather than **Link**. High resolution meshes tend to stretch less when **Scaling Relation** is set to **Object** rather than if **Scaling Relation** is set **Link**. For more information, see *Scaling Relation* in the *nDynamics* guide.

To edit Scaling Relation

- 1 In the scene view, select the medium resolution nCloth pants.
- 2 In the **Attribute Editor**, click the **nCloth_Pants_MedResShape** tab.
- 3 In the **Dynamic Properties** section, set **Scaling Relation** to **Object Space**.



- 4 Cache the simulation (**nCache > Create New Cache**), and play it back.

Compare all three versions of nCloth

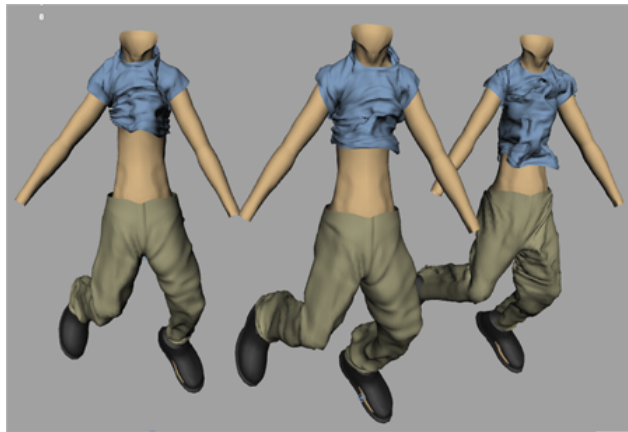
To compare all three versions of nCloth

- 1 Ensure that:
 - The **Shirt_MedRes**, **Pants_MedRes**, **Shirt_LowRes**, and **Pants_LowRes** objects are hidden.
 - All objects in the **Character_HighRes** group are shown in the scene.
- 2 In the Display Layer editor, turn on **Visible** for the **Reference_Character** object in the scene view.

- 3 Scrub through the **Time Slider** to compare how the nCloth meshes behave in the animation. Dolly and tumble the scene so that you can closely observe any subtle differences in the nCloth.

NOTE

If the Reference_Character is not animated in the scene view when you play back or scrub the simulation, you may need to reconnect the reference character's caches to their respective objects. See [Reconnecting objects to existing caches](#) (page 35).



When you compare the three versions of nCloth, you have to look closely to notice the subtle differences in behavior. Considering the amount of time saved optimizing a low resolution mesh, this workflow provides a viable alternative to simulating highly detailed character clothing. By wrapping your highly detailed mesh onto a lower resolution nCloth instead of simulating it, you can still model details into mesh without worrying about how it simulates.

By saving the low resolution nCloth attributes as a custom preset, you add value to the time invested in optimizing the nCloth simulation. After applying the preset to the medium resolution nCloth, only minimal adjustment is required to obtain a simulation with good results.

