CHARACTER ANIMATION

BCADES-208

BLOCK 1:

INTRO & ANATOMY

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"Education is something which ought to be brought within the reach of every one."

- Dr. B. R. Ambedkar

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Block

1

INTRO & ANATOMY

Acknowledgment

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

Unit 1 Introduction to Character Studio

Learning Outcome

After going through this unit, you will be able to:

- Discuss the character studio
- Enumerate the different elements of character studio
- Explain biped, physique, footstep, freeform, motion capture
- Enlist the biped Properties
- Elaborate on Workflow

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

1.1 Introduction to the Character Animation

1.2 Introduction to the Character Studio

1.3 Biped

1.4 Overview of Biped Properties

1.1 Introduction to Character Animation

Character animation is the animation to create the illusion of life, usually as one aspect of a larger production and often to complement voice acting. Character animation is creatively unique from other animation in that it involves the creation of perceptible thought and emotion, in addition to physical action.

The book is totally designed in a manner that you have a better look over the complete character studio in brief as well as understand the workflow and solve all the problems that you may encounter while practicing character studio.

Here you will have a complete look over what is character animation as well as learn how to animate characters using “Biped”.

Character animation is a technique of applying basic principles of animation (realistic actions, emotions, anticipation and flexibility) to a character. It is not necessary that a character should be a replication of a living being, means 3D animation dropping a life in non living thing as a human being has in real world. It can be anything. It can be a table, a pencil, an egg, a headphone, a vehicle. The above stated qualities make it a character. If an object has all these qualities, it is a perfect character. It should be such that the person watching it needs to understand what exactly that object is trying to present or tell us.

After looking at these lines,you have ideas as to how to bring a non-living thing to life. That is the demand of today’s people, no matter what their age. They want entertainment. Moreover, always remember that in character animation / movies, it is the toughest job to make someone really laugh wholeheartedly. Therefore, as you can see, the big daddies of the animation industry like “PIXAR”, “DreamWorks”, “Disney” arecalled big daddies because they have been doing it since 20-30 years.They have consistently produced movies such as CARS, ICE AGE, One Man Band, The Incredible, Finding NEMO, Monster’s Inc. and SHREK.

Of course,all the animations are not done using biped and physique. They use the Bone system and a lot of Scripting to create a more realistic look and dynamics in character animation. However, this is where you can do the character animation in the easiest manner. This is where you do not have to worry about hierarchy, links, solver etc. Everything is at yourfingertip and you can do what youwant in a wink.

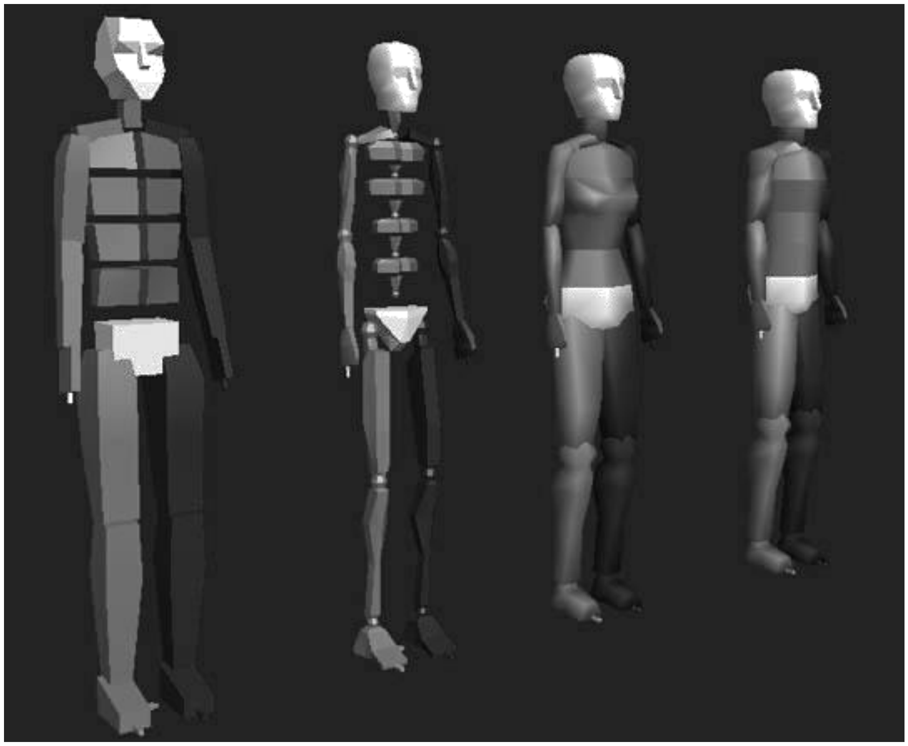

Fig. 1.1: Bipeds

So let us begin with the Charact er Studio and see how it works.

1.2 Introduction tothe Character Studio

Character studio is the powerful tool(extension) of 3ds max. Character studio gives a panoptic range of tools for mo tion capture,free-form animation and footst ep animation. Character studio provides a solution animating bipedal (2-legged) characters. W ith character studio (CS),you can animate in an environment that is fun, easy to use and forg iving, when it comes to the editing motion. Tw o principle parts of the character studio are:

1. Biped: a structure of bone in the form of human bone structure.
2. Physique: bones connect to body(skinning)

The word BIPED itself defines the two legged skeleton system.With biped,you can create a skeleton that can be us ed and customised to fit a host of characters. Here you can use 3 methods for animation to bring characters to life.

1. Footstep: readymade anima tion
2. Freeform:Should be created manually
3. Motion capture

There is an excellent thing in CS, i.e. you can create an animation and can apply it to any biped. These motions can be cut and pasted or blended together with the Motion Flow editor, which will be covered in the upcoming sessions.

CS uses an envelope-based system called Physique to bind the target mesh's vertices to the skeleton. Physique is compatible with any 3ds max based bone system and can be the source of its own animation through muscle bulging and skin sliding.

Physique is a modifier that works on all 3ds max surface types; you access physique from the modifier list drop down.

Study Notes

Assessment

1. State True/False: Motion flow is the readymade animation.
2. Describe in short "Introduction of Physique".

Discussion

1. Draw all different types of biped.
2. Define allparts of the biped.

1.3 Biped

Biped is a fully integrated skeleton system for bipedal structure, but it is not limited to the human figures.

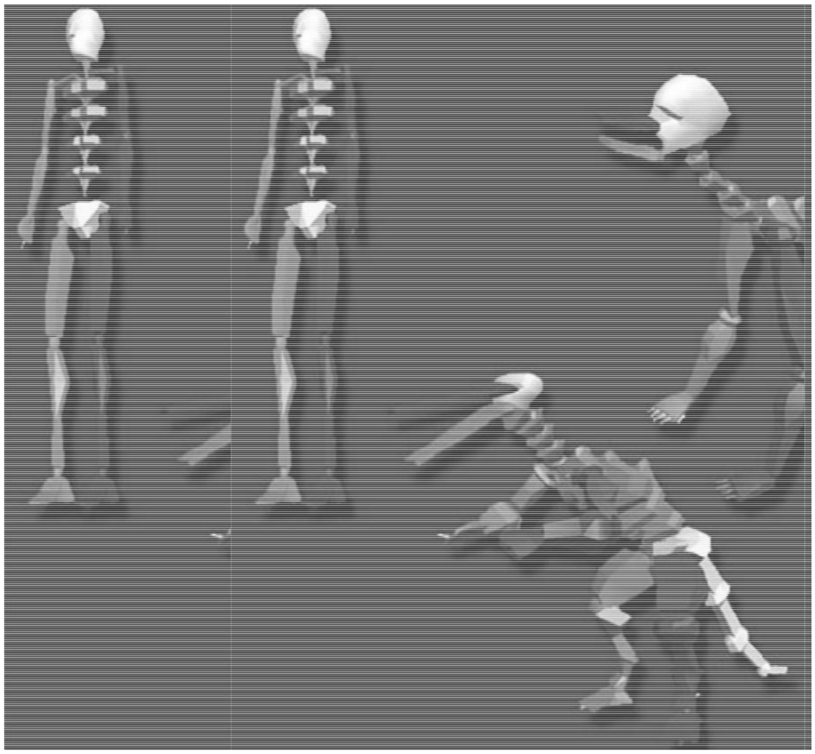

Fig. 1.2: Biped and Quadruped

By modifying the size of the bones and the number of links,you can create a wide variety of creatures. Biped bones do not require filling the space in the target mesh, but the rotation points of the bones need to match with their counterparts.

Bipeds can even be com bined by linking the end of one hierarchical cha in to the root object of another biped to form multipedal creatures. Biped uses the paradigm (pattern) of a body; it is either at rest or in m otion. If the biped is not being animated eith er by placing footsteps or manually setting t he key frames, it is in the process of being p osed to fit an existing mesh.

Therefore, it is very important to understand various modes and file types that the CS uses.

	Study Notes

	Assessment

1. COM Stands for ________________.
2. Biped is 4-legged.(True or False)

	Discussion

Create a character and draw the biped for it.

1.4 Overview of Biped Properties

Till now you have studied the concept of biped.After getting the concept, you can well understand the different properties of biped. A general overview of biped properties is given below:

1.4.1 FIGURE MODE

The screen shot of figure mode is given below:

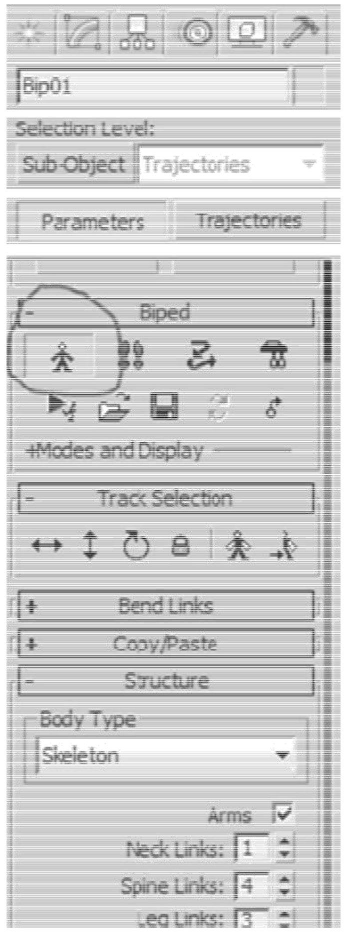

Fig. 1.3: Figure Mode

This mode comes under the motion panel.

With the figure mode, y ou can change the biped's structure and fit tha t structure to a character mesh. The changes done in this mode can be preserved even if you exit from the mode. It can be used for a variety of other procedures.

1.4 .2 PHYSIQUE

Another component of t he CS is Physique, which is used to attach the sk eleton to any 3ds max geometry types. The screen shot of same is given below:

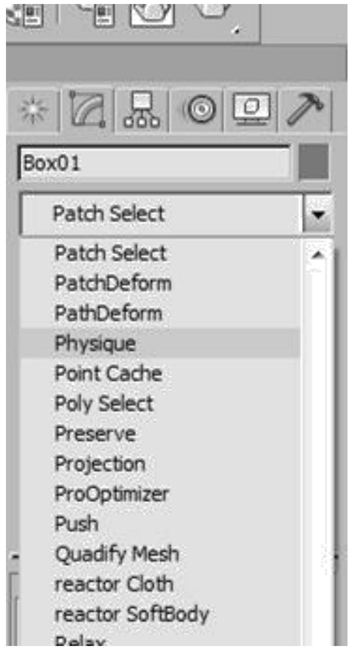

Fig. 1.4: Physique Modifier

In addition to a biped created in CS, Physique can use any hierarchical s tructure as its skeleton such as Max's internal b ones or spline object.

Physique resembles the S kin Modifier, but has more features for finer co ntrol. Physique supports the following two modifiers:

- Sub object Tendons
- Bulges

1.4.3 SUB- OBJECT

Following are the sub objects of Physic modifier.

a. TENDONS

   Allows the skin to stretch ov er multiple bones

b. BULGES

   Expands the skin based on the angle of the connected bones

c. USING ENVELOPES

All the vertices in the target geometry should be assigned to the bone or else they are left behind as the skeleton m oves ahead.

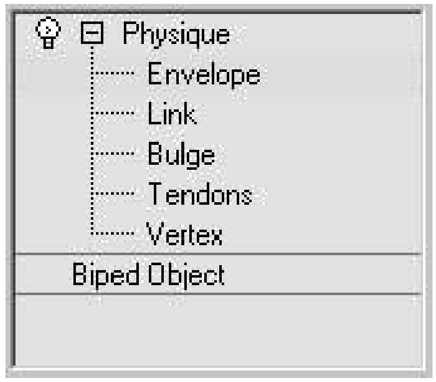

Fig. 1.5: Sub Objects of Physic Modifier

The assignment can be controlled visually using envelopes. Physique goes through the geometry and from that, it can be understood which vertex belongs with which bone.

Deformable V/S Rigid Vertices

Physique controls the vertices o f skin in two ways:

Deformable: Deformable vertices have superior control features associated with them. They follow the deformation spine created through the hierarchy. Typically, you use deformable vertices when you attach a mesh to the biped pelvis to produce a soft, flexible skin. Deformable vertices are shown in the view ports as red vertices.

Rigid: Rigid vertices are attached to the bone and move in an immobile relationship. They are primarily used for areas such as head, which should not be affected by other bones. Rigid vertices are shown in gree n colour in the view ports.

	Study Notes

Assessment

1. Where doyou get the Physique in 3ds max?
2. Which rollout is used to customise the biped?

Discussion

Create the four-legged character by Biped,which is skinned with mesh four-legged character.

1.5Workflow

The Typical Workflow

While working with the CS, a typical workflow includes these basic steps:

- Create a character
- Create a Bipedal Skeleton
- Apply a Physique Modifier
- Test the character
- Animate the character

Let us discuss the above steps in detail in order to make these steps clearer and easier for you to understand.

1.5.1Create a Character

You can select or create a suitable character. CS works well on Low and High polygon count characters, but the lower polygon count is easier to animate. Care should be taken at the areas like Joints. It is easy to overstretch these places and cause distortions.

Create a Biped

Now to create a biped,specify and scale the biped to match the target mesh as closely as possible. It is important to talk to the design team to determine the overall scale of the scene. It is difficult to scale an animated biped,so consistency in units is crucial.

Apply a Physique Modifier

Once the biped is in place, apply a physique modifier to the character mesh. You edit vertices and envelopes to conform to the geometry and minimise distortion.Take a decision as to which sections will be rigid and which will be deformable.

1.5.2Test a Character

After attaching the biped with the character, i.e. after applying the physique modifier, the next step is to check the physic binding for any "bad vertices". You can call any wrongly connected or unconnected vertex as a bad vertex. Wrongly connected means that the vertex in question is influenced by a link, which is closer to that vertex than the link which is supposed to influence that vertex. This mostly happens in case of fingers, toes and thighs.

Testing a character for "bad vertices" using CS is a repetitive process. You can move various limbs about by curling and uncurling fingers and swinging legs to check for bad areas or unassigned vertices.

If your character is a stiff butler, your testing does not need to be too rigorous. If your character is a supple kick boxer with dynamic moves, you need to undertake a more thorough testing phase.

1.5.3 Animate the Character

Biped Features

There are three primary methods for adding animation to your character.

- Footstep
- Freeform
- Motion Capture

Any of these can have additional key framing on the top to personalise the animation and to combine the animation in various ways.

You can use any of the options or even mix up the above three methods to animate your character.

Footstep animation allows you to create simple footsteps for walk, run or jump. You can animate or mix them to create the desired animation. Footstep animation can be created from Footstep Mode.

Freeform animation allows you to animate the character in whatever way you want. You can animate your character to perform animations such as fly, swim, swing, fall etc.

Motion Capture is a technique in which you record the real life motions and then you can apply the same to the Computer generated characters. The recording of the motion, which is also called as Motion Capture, is done using the specialised devices. This can be wired, optical, magnetic or laser based.

Fig. 1.6: A Movie Star wearing a Motion Capture Suit and the Output

	Study Notes

	Assessment

1. Write the basic steps, which are includedin the typical workflow while working with character studio.
2. The biped pelvis is the direct child of the __________.

	Discussion

Create a character with a cylinder, apply biped and physique on it and animate it with footstep and freeform animation.

1.6 Summary

INTRODUCTION TO THE CHARACTER STUDIO

Character studio provides a solution animating bipedal (2-legged) and Quadruped (4-legged) characters.

Biped is a fully integrated skeleton system for bipedal structure, but it is not limited to human figures. It uses an envelope-based system called Physique to bind the target mesh's vertices to the skeleton. Physique is compatible with any 3d max based bone system and can be the source of its own animation through muscle bulging and skin sliding.

BIPED

Bipeds can even be combined by linking the end of one hierarchical chain to the root object of another biped to form multipedal creatures. Biped uses the paradigm (pattern) of a body; it is either at rest or in motion. If the biped is not being animated either by placing footsteps or manually setting the key frames, it is in the process of being posed to fit an existing mesh.

OVER VIEW OF BIPED PROPERTIES

Deformable vertices have superior control features associated with them. They follow the deformation spline created through the hierarchy. Typically, you use deformable vertices when you attach a mesh to the biped pelvis to produce a soft, flexible skin.

Deformable vertices are shown in the view ports as red vertices.

Rigid vertices are to the bone and move in an immobile relation relationship. They are primarily used for areas such as head, which should not be affected by other bones. Rigid vertices are shown in the green colour in the view ports.

THE WORKFLOW

The centre of mass, also referred to as COM, is the biped's root and can be used to translate or rotate the entire biped at once.

1.7 Self-Assessment Test

Broad Questions

1. What is character studio?
2. What are the different modes available for biped in the motion panels? Discuss them in detail.
3. Define the character studio's work flow.

Short Notes

a. Bipedand its uses
b. Physique and its uses
c. Motion Capturing
d. Sub-objects of Physique
e. Character Animation

1.8 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese

5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Create various Bipeds with varying parameters like height, neck links, fingers, finger links, tail, props etc.

Unit 2 Biped and Freeform Animation

Learning Outcome

After going through this unit, you will be able to:

- Define Centre
- Explain the Anatomy of Biped
- Discuss customising Biped
- Elaborate on foot step creation rollout
- Discuss footstep operations rollout
- State name rollout
- Practise with free form Animation

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
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Content Map

2.1 Introduction to Biped

2.2 Anatomy of Biped

2.2.1 Centre of Mass

2.1 Introduction to Biped

Biped provides a simple yet powerful solution for setting up and animating two-legged characters with just a few clicks of the mouse. You do not need to struggle with constraint setups and expressions,you do not need to decide to customise and combine them to build virtually any creature you can imagine.

A biped is a hierarchy of “intelligent” links represented by boxes simulating a bipedal skeleton. One box for each link of the hierarchy is shaped to roughly simulate the structure and contour of an average humanoid with a number of customisable parameters to define the number of links in each major region such as the spine, neck, arms, fingers, legs and toes. The box also acts as a visual reference for animating.

Creating biped rollout letsyou control the structure of your biped. With a little creativity,you can create some interesting non-human forms. Youcan turn off the arms for the characters that do not need them and adjust the number of leg links for the creatures like kangaroos or birds.

Youcan use ponytails not only as actual ponytails but also for trunks or big floppy ears.

Even the horizontal placements of the foot can be made in relation to the leg with ankle attach control. You can customise your biped before or during creation by adjusting the settings for any of the parameters found in create biped rollout. The same is shown in the given figure:

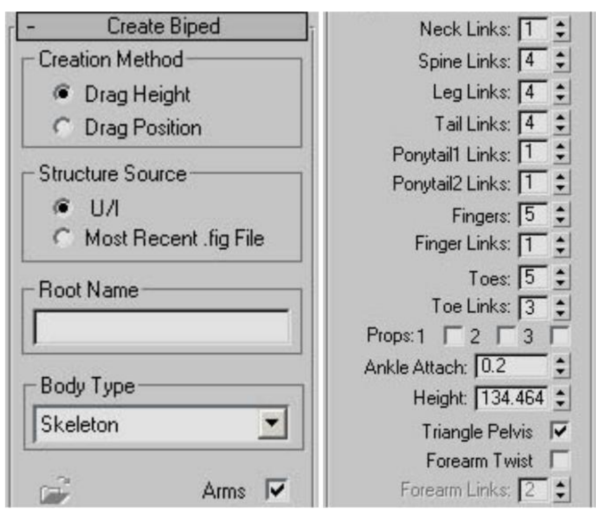

Fig. 2.1: Create Biped Rollout

2.2 Anatomy of Biped

To be able to create and pose or animate a biped, it is important to u nderstand its structure and the behaviour of e ach element.

2.2.1 CE NTRE OFMASS

The centre of mass, als o referred as COM, is the biped's root and ca n be used to translate or rotate the entire bip ed at once.

At the centre of the pelv is is an object called Centreof Mass (COM). Th e COM is the root of the biped's hierarchy and the central pivot for the whole figure. It is labelled as Bip# (Where # represents a number) by default when it is created. This name is no t only for the root, but is added to each joint in the biped's hierarchy.

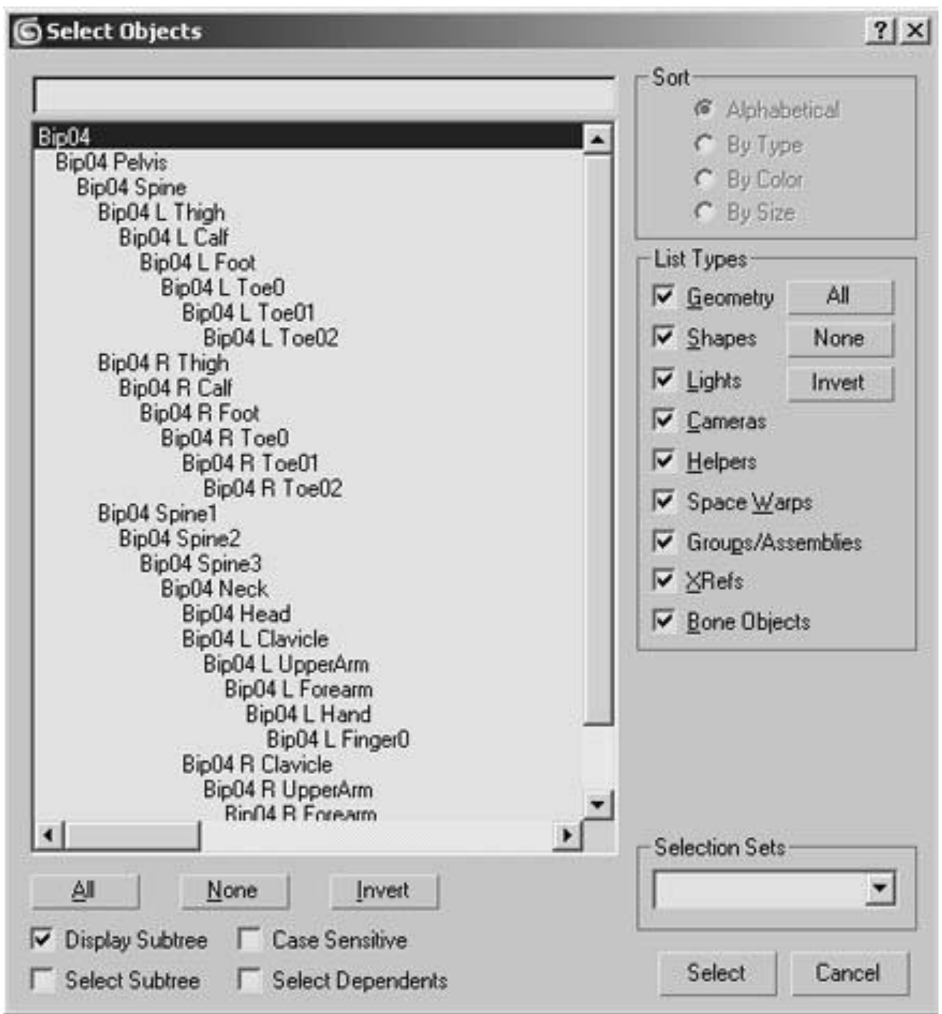

Fig. 2.2: Biped's Hierarchy

If the name of the COM h as to be changed, it has to be done during the creation time or else it will carry the same name as well in each link in the biped and you c ould need to rename each of these. The renaming is very important for the organisational r easons when you have more bipeds in the scene.

The track selection rollo ut has the tools to help us select and manipul ate the entire biped at once. You can select COM object quickly without having to click in the view port.

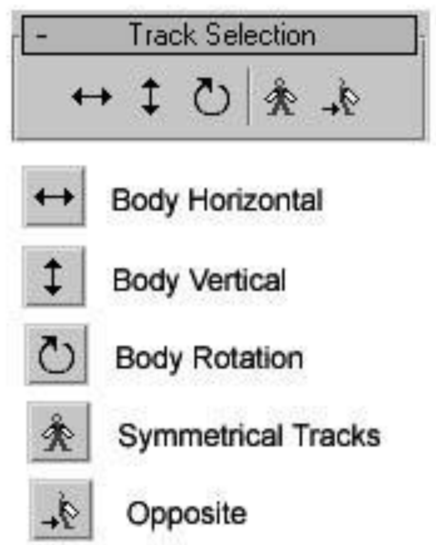

Fig. 2.3: Track Selection Rollout

Body Horizontal:Selects t he COM to edit horizontal biped motion

Body Vertical:Selects the COM to edit vertical biped motion

Body Rotation:Selects the COM to edit biped rotational motion

Symmetrical Tracks:Sele cts the matching object on the other side of the biped

Opposite:Selects the matching object on the other side of the biped and deselects the current object

The COM is the integral part of the biped's unique dynamics anim ation system. When the motion dynamics are active, the COM behaves much likethecentre of gravity. If your centre of gravity is too far forward or backward, then your body tends to bend, compensate and stay balanced.

Biped's intelligent animation system uses the COM to balance the fig ure from one pose to another.

The pelvis is the direct child of the COM. It is the link that defines ho w the legs are attached to the spine. Here,you can use either the standard pelvis or the triangular pelvis.

Fig. 2.4: Biped Cr eation Rollout showing Triangle Pelvis Option

For the triangular pelvis, choose the triangle pelvis option.

It does not change the s hape of the pelvis but changes the manner howw the legs join the spine. This becomes more im portant when deforming geometry with physique. Physique creates splines that follow the b iped's spline and the deformable geometry uses that spline to create the bends that make t hem feel more organic.

The pelvis area can create problems when the mesh is deformed w ith Physique. Triangle Pelvis makes more natural spline for mesh deformation.

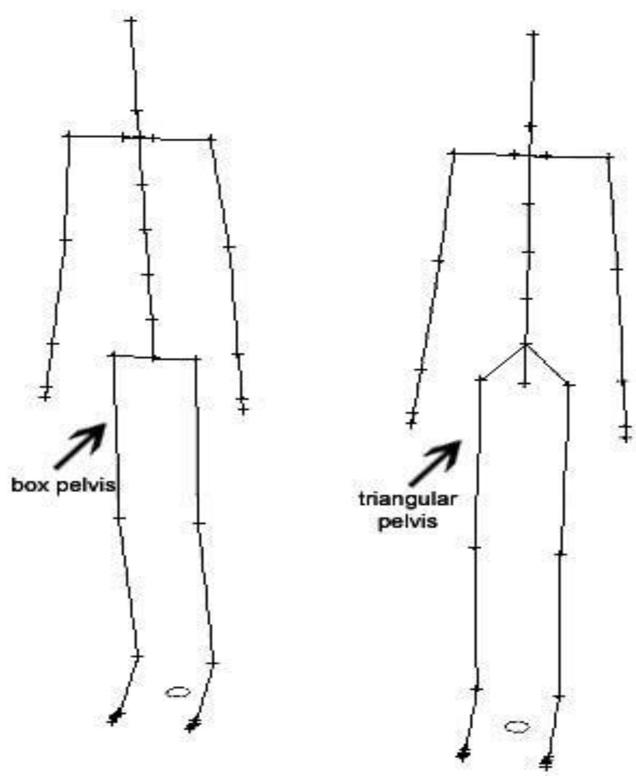

Fig. 2.5: Difference between Box and Triangle Pelvis

The standard or the box pelvis joins the legs to the spine at right angles. This leads to an unnatural deformation at the hips since in real life your hips are actually below the spine.

The triangular pelvis acts more like a typical human pelvis, so the geometry tends to flow more believably.

The foot and toes are separate objects from the leg but are still controlled by the leg. They are constrained to follow the position of calf, but not the rotation.

When working with the Biped, it is best to work using the Reference coordinate system, set the world for the translation and local for rotation. This gives us the best performance and allows your controls to remain consistent.

Study Notes

Assessment

1. Proportionately, the legs are almost half the height of body. (True or False)
2. What are the primary methods used in creating biped animation?

Discussion

Create the female character’s biped and discuss its anatomy.

2.3 Customising Biped

The biped's creation tools are very flexible. You can access all your parameters, which allow us to adjust not only the poses but also the structure of the biped. If you create a biped and suddenly realise that you require more joints in the fingers, more flexibility in the neck or want to add a ponytail or a tail, then you can access the structure's parameters and do the modifications needed. These changes can also be done even after you have done animation.

Biped adjusts the key frames to accommodate the changes you make or even if you add an extra link to the character.

CS has separated the setup phase from the animation phase by using the Figure Mode and freeform or Footstep animation mode. In free form animation mode, the changes to the model are limited.

If you want to make changes to the base pose or the actual structure of the biped,you need to work in the Figure Mode.

Uses of figure mode in CS

- It is a reference position to fit a biped to a mesh.
- Used for biped adjustment after a mesh is attached to correct biped joint location
- Used for biped adjustment after a mesh is attached to correct posture in a motion fill
- Used to define biped structure
- Turn Figure mode on to scale a character.
- Reverse-Knee Characters

Keep the following things in mind when you work with Figure Mode

- Animation tools are disabled, i.e. you cannot set the keys or view animation.
- All rotation and scaling is done in local space.
- The Reference Coordinate system option is not available for rotations, although you can still translate in other coordinate space as needed.

There are actually four modes available:

Figure mode is used to change the biped skeletal structure and to align the biped to a mesh.

Footstep mode is used to create and edit footstep animation.

Motion flow mode is used to create scripts that combine motion files into longer animations.

Mixer mode is used to view, save and load animation created with the motion mixer.

Figure Mode: Figure mode can be used to fit a biped to the mesh or mesh objects representing your character. The structure rollout appears when figure mode is active.

Footstep Mode: Footstep mode is used to create and edit footsteps; generate a walk, run or jump footstep pattern; edit selected footsteps in space; and append footsteps using parameters available in footstep mode.

There are two additional rollouts display on the Motion panel when Footstep mode is active:

1. Footstep Creation rollout
2. Footstep Operations rollout

Study Notes

Assessment

1. Which rollout button customises the biped?
2. Mixer mode is used to view, save and load animation created with the Motion Mixer. (True or False)

Discussion

Create the Biped and adjust it with figure mode.

2.4 Footstep Creation Rollout

The Footstep Creation rollout available on the Motion panel when Footstep mode is on, provides controls for creating and editing footsteps. You can create a walk, run or jump footstep pattern using these controls.

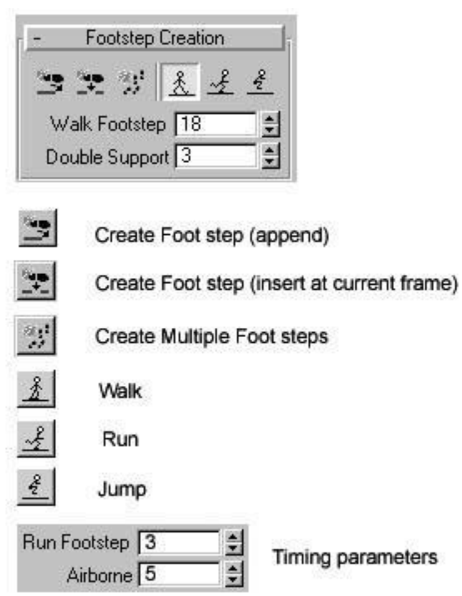

Fig. 2.6: Footstep Creation Rollout

Create Footsteps (Append): Each new footstep is appended to the end of the biped's footstep sequence.

Create Footsteps (Insert at Current Frame): Createsfootsteps at the current frame

Walk: Sets the biped gait to walk

Run: Sets the biped gait to run

Jump: Sets the biped gait to jump

	Study Notes

	Assessment

1. In which rollout do you get run, walk and jump?
2. What are the different methods of Footstep Animation?

	Discussion

Create biped and apply footstep animation with walk, run and jump.

2.5 Footstep Operations Rollout

Once footsteps are created by using the Footstep Creation rollout, you can use parameters on the Footstep Operations rollout to activate and deactivate footsteps and to adjust the path of footsteps.

Motion Flow Mode: This mode creates scripts and editable transitions are used to combine ‘bip’ files together to create custom character animation in motion flow mode. After creating scripts and transitions, save segment on the biped rollout is used for storing a script as one long ‘bip’ file. Save as ‘mfe’ file enables you to save and continue motion flow work in progress.

Mixer Mode: Activates any current mixer animation on the biped and displays the mixer rollout.

Fig. 2.7: Mixer Rollout

Biped Playback: Plays the animation for all bipeds unless they are excluded on the display preferences dialog.

Load File: The open dialog let you load .bip, .fig or .stp files.

Save File: Opens the save as dialog, where you can save biped files (.bip), figure files (.fig) and step files (.stp) files.

Convert: This option converts footstep animation into a freeform animation. This option works in both directions; it displays the convert to freeform dialog or converts to footsteps dialog depending on the direction.

- Convert option uses biped foot IK Blend values to extract footsteps.

- Use convert to extract footsteps from an animation saved using save segment in motion flow mode.

- Convert the animation in either direction based on how you like to work. Convert to freeform for unrestricted key editing or convert to footsteps to take advantage of footstep animation.

Move All Mode: Allows the biped to be moved and rotated with its relative animation intact.

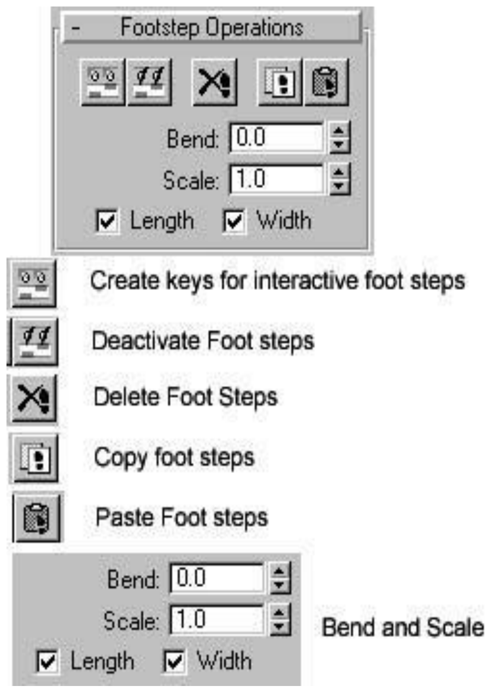

Fig. 2.8: Footstep Operation Rollout

Create Keys For Inactive Footsteps: Activates all inactive footsteps. Activation creates default keys for any footsteps that do not have them.

Deactivate Footsteps: Removes the body keys assigned to the selected footsteps, making those footsteps inactive. The footsteps themselves remain in the scene.

Delete Footsteps: Deletes the selected footsteps.

Copy Footsteps: This option is used to copy the selected footsteps and biped keys to the footstep buffer. Biped will only copy a constant sequence of footsteps (1, 2, 3, 4, 5...). You cannot copy irregular footsteps (3, 4, 7, 8...).

Bend: Bends the path for the selected footsteps.

Scale: Changes the width or length for the selected footsteps.

Length: When length is selected, the scale spinner changes the stride length of the selected footsteps.

Width: When width is selected, scale changes the stride width of the selected footsteps.

Modes Group

The various modes of group are discussed below:

Fig. 2.9: Modes Rollout

Buffer Mode: This edits segments of an animation in buffer mode.

Bend Links Mode: Bend all the biped spine objects naturally by rotating a biped spine object. Bend links also works for the biped tail and ponytail links.

Rubber Band Mode: If you want to reposition biped's knees and elbows, turn on figure mode and then turn on rubber band mode. In order to shift the biped's centre of mass relative to the rest of the biped skeleton, turn on figure mode, turn on rubber band mode and shift the centre of mass. Rubber band mode acts differently than non-uniform scale.

Scale Stride Mode: Footstep stride (walk) length and width are scaled to match the stride (walk) length and width of the biped figure. By default, scale stride mode is on, so scaling happens automatically when you load a .bip, .stp or .fig file.

In Place Mode: You can use this mode to keep the biped visible in the view ports while the animation is playing. Use this for editing the biped key or adjusting the envelopes with physiquemodifier.

In Place X Mode: Locks centre of mass x-axis motion. Use this for game export where the character stays in place but the swinging motion of the hips and upper body along the y-axis is preserved.

In Place Y Mode: Locks centre of mass y-axis motion.

Study Notes

Assessment

1. Write the extension of Biped file, Figure file and step file.
2. Which mode creates scripts and editable transitions that are used to combine ‘bip’ files together to create custom character animation?

Discussion

Create an animation with Biped, save it and again load it with a new file.

2.6 Name Rollout

The Name rollout allows youto change the name of the biped.

SAVING A BIPED STRUCTURE AND LOADING A .FIG FILE

When you save a biped in the figure mode,you use a special format called a figure (.fig)

Unlike the biped format (BIP) which saves the animation's data, the FIG file contains only structural parameters that define the biped.

If you want to save the file, switch on the figure mode and click on the Save File Button. This will save the file in .fig format. Otherwise, just by clicking on the save file button the data will be saved in .bip format.

	Study Notes

	Assessment

1. Give the file extension for a file, which saves in the figure mode.
2. Give the extension for a file that can save the biped animation file.

	Discussion

Create biped and save the biped in .fig.

2.7 Free Form Animation

Free form animation is a very convenient and powerful method for creating walking, jumping and running bipeds. Sometimes however,you may want a biped to fly, swim, climb, drive, stretch and ride a bicycle, skate or surf free of footsteps. In these types of animation, the feet move around a lot rather than moving from one stationary position to another.

Here instead of using a footstepanimation,you can use a free form. With a free form,you can tell the biped when and where to move.

Free form removes the dynamics, releasing the biped from constraints of gravity and other footstep constraints. However, of course it is a headache to create realistic character animation.

There are two types of biped free form animation. These are discussed below.

2.7.1 Purely Free Form Animation

Here the biped is animated with complete free form techniques. There are no footsteps in this type of animation. It is appropriate when a biped's feet are always moving and never planted. This is created by the techniques that are already familiar to us in 3ds Max. Here instead of making footsteps,you simply turn on the animation button and start moving and rotating the biped.

2.7.2Free Form and Foot Step Combined

Here the biped is animated with the combination of free form and footstep techniques.

It can also be used in conjunction with the footsteps. You just need to designate a range of frames as the free form area. Once this range is set, the biped does not respond to gravity or other dynamic functions during those frames. However, it will return to using biped dynamics on frames where footsteps are present.

In order for a frame range to be used as a freeform area, the following criteria must be satisfied:

- At least one footstep must be present at either end of the range.
- The biped must be in the air (no footsteps) in the frame range.

Display Group

The features of display group ar e discussed below:

Display Objects Fly Out: this fly out lets you display bones and object s, together or independently.

Objects:displays biped b ody objects.

Bones:displays biped bo nes.

Fig. 2.10: Display Group Rollout

Objects and Bones:displ ays bones and objects simultaneously.

Display Footsteps Fly Out:this fly out lets you display or hide footsteps and their numbers:

Show Footsteps and Nu mbers:displays biped footsteps and footstep numbers.

Show Footsteps:displays biped footsteps in the view port, but no footstep numbers.

Hide Footsteps:turns off footsteps and footstep numbers in the view po rt.

Forearm Twist:toggles th e display of extra forearm links used to set twi sting.

Leg States:when this button is on, the view port displays move, slide and plant at each foot at the appropriate fra me.

Trajectories:displays trajectories for selected biped limbs.

Display Preferences:this option displays the preferences dialog, whi ch is used to alter footstep colours, trajectory parameters and to set the number of bipeds, which can be played back when you use biped playback on the biped rollout.

2.7.3 Footsteps in Track View

After you have selected the number of footsteps, their timing, length and height in the Create Multiple Footsteps o ption can be edited in various ways. You can relocate and reorient the footsteps directly in the view port.

However, the timing of t he footsteps can only be changed in the track view.

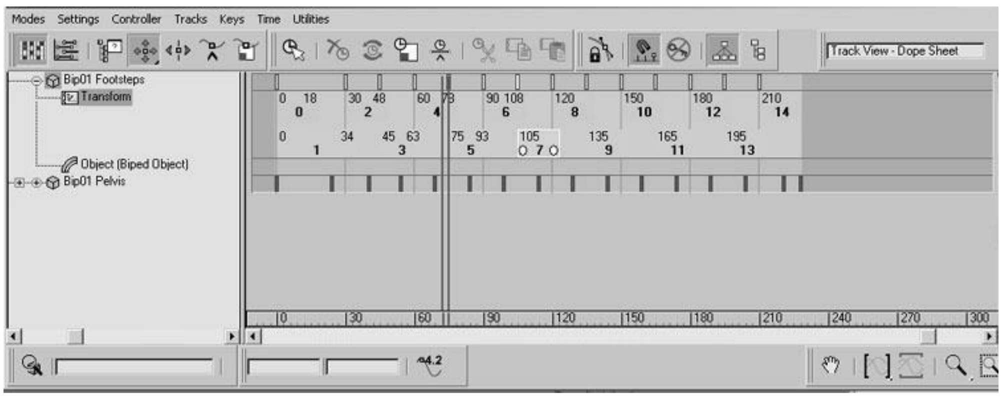

Fig. 2.11: Footsteps in the track view

Upper Bo dy Animation

The standard “out-of-the-box” biped gaits are quite flat. They provide the basic gaits to modify, to animate or to give life. In order to do so,you often must apply transforms to appropriate parts to simulate natural motion or exaggerate motion.

2.7.4 Anchoring Feet and Hands

Anchors are used in a variety of situations where positioning a limb is important. Always remember that it is a tem porary tool and not a permanent fix for an ani mation.

Sometimes the job woul d be much easier if you pin down the biped’s h and or foot in a place while you make other adjustments. Biped provides four buttons in the keyframing rollout.

Enable Subanimsenables biped subanims.

Manipulate Subanimsmo difies biped subanims.

Clear Selected Tracksrem oves all keys and constraints from the selected objects and tracks.

Clear All Animationremoves all keys and constraints from the biped.

Mirror: mirrors the entire biped animation.

Set Multiple Keys: select keys using filters or apply a rotational increment to selected keys.

Set Parents Mode: when a limb key is created, keys are also created for the parent objects if set parents mode is turned on, use set parents mode with separate tracks turned on.

Anchor Right Arm / Left Arm / Right Leg / Left Leg: this option lets you fix the position and orientation of biped's hands and feet temporarily. You can use anchors while setting up animation with inverse kinematics object space, in which the arm or leg follows an object in the scene. Anchorsmake it sure that the arms or legs keep its alignment until you set the second key that creates the object-space sequence.

Show All In Track View:shows all the curves for the options in the keyframing rollout in the track view.

2.7.5 Separate Tracks

Various separate tracks are discussed below:

Arms:turn on to create separate transform tracks for the finger, hand, forearm and upper-arm.

Legs:turn on to create separate toe, foot and calf transform tracks.

Ponytail 1:turn on to create separate ponytail 1 transform tracks.

Ponytail 2:turn on to create separate ponytail 2 transform tracks.

Neck:turn on to create separate transform tracks for the neck links.

Tail:turn on to create separate transform tracks for each tail link.

Spine:turn on to create separate spine transform tracks.

2.7.6 IK Blend

As you know, in Forward Kinematics (FK) a parent object is animated and the child object follows. When you transform a child object, the parent does not follow along, whereas in Inverse Kinematics (IK), the child object is animated and the parent follows along.

In CS, one part of the body can use IK while the other uses FK. For example, when a biped's foot is in a walk footstep, it uses IK to keep the foot anchored to one spot while the rest of the body moves around it. However, the foot in the air is using FK, so it follows the body. One foot is using IK while t he other is using FK.

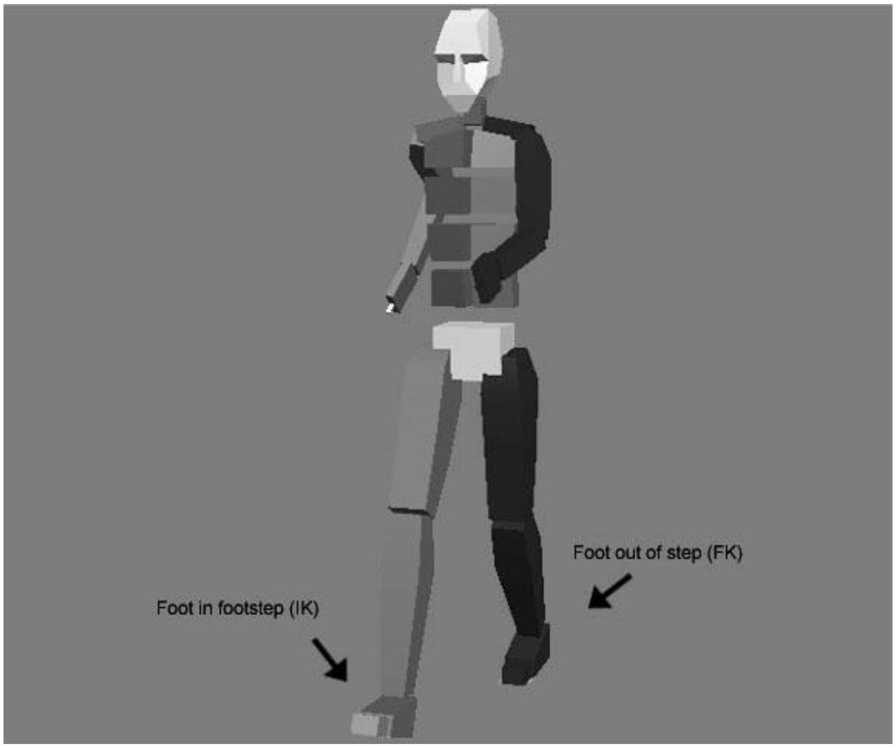

Fig . 2.12: Difference in IK and FK

In addition, the feet can alternate between IK and FK. When the biped's foot leaves a footstep, it switches from IK to FK and follows the body as it moves. Whether the foot is using IK or FK at any time is determined by the IK Blend parameter in the IK Key Info rollout.

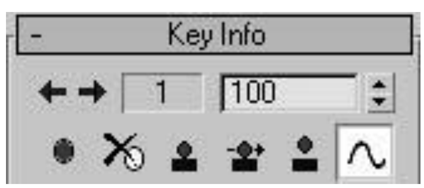

Fig. 2.13: Key Info Rollout

When IK Blend is 1, IK is in force. This means that the foot stands on o ne place and the body moves around the foot. When IK Blend is 0, FK is in force and the foot follows along with the body. The IK Blend parameter can be animated to make the foot stay still (IK Blend=1) then later follow the b ody (IK Blend=0).

When you create Keys for the Inactive Footsteps, the IK Blend p arameters is automatically animated between 0 and 1.

The rule for the biped fe et is also applied to the biped hands.

Body an d World Space

At any given time, a biped hand or foot is said to be in a particular type of spac e:

- When the hand or foot is following the body, it is said to be in bo dy space. For example,the foot is in the bo dy space when it is in the footstep
- When the hand or foot is m ade to stay still somewhere in space but is n ot following a particular object, it is said to be in world space.

There is one more space, i.e. Object space.

Setting Keys

In order to set IK Blend o r Body / Object setting for hand or foot,you ca n choose any part of the appropriate arm or le g and change the settings in the rollout.

Fig. 2.14: Buttons for Setting Keys

IK Buttons

Character Studio anticipates some of the more commonly used IK Bl end and Body object settings. This includes th reebuttons, which help us to work more efficiently. These keys are explained below:

Set Planted Key

Sets IK Blend to 1.0 and chooses the object option. This pins the han d or foot to a point in the space until a free key is encountered.

Set Sliding Key

Set IK Blend to 1.0 and c hooses the object option. This is similar to set planted key in those hands and feet, which ar e still pinned in space. However, whenever yo u create a key using this feature, Join to Prev. K ey is turned off. The hand or the foot can be a nimated but it will still behave in the IK mode, the arm or leg will followit and the body will move around. This type of the key is best understood for practice.

Set Free Key

Sets IK Blend to 0.0 and c hooses the body option. This sets an FK key.

The convert button can be used to convert a freeform to footstep animation or footstep to freeform animation.

A freeform animation can be converted to footsteps under specific circumstances.

Study Notes

Assessment
1. Which Button gives view port displays of Move, Slide and Plant at each foot at the appropriate frame when it is visible? 2. How many buttonsare included in IK Buttons, which help us work more efficiently?

Discussion
Create freeform animation using set planted key and set key.

2.8 Summary

INTRODUCTION TO BIPED

Biped is a fully integrated skeleton system for bipedal structure, but it is not limited to the human figures. A Biped Is A Hierarchy Of "Intelligent" Links Represented By Boxes Simulating A Bipedal Skeleton. One Box For Each Link Of The Hierarchy, Shaped To Roughly Simulate The Structure And Contour Of An Average Humanoid From With A Number Of Customisable Parameters To Define The Number Of Links In Each Major Region Such As The Spine, Neck, Arms, Fingers, Legs And Toes.

ANATOMY OF BIPED- CENTEROF MASS

To be able to create and pose or animate a biped, it is important to understand its structure and th behaviour of each element. The centre of mass, also referred as com, is the biped's root and can be used to translate or rotate the entire biped at once. It is labelled as bip# (where # represents a number) by default when it is created.

Triangle pelvis creates a more natural spline for mesh distortion. It does not change the shape of the pelvis but changes the manner how the legs join the spine. This becomes more important when deforming geometry with physique. Physique creates splines that follow the biped's spline and the deformable geometry uses that spline to create the bends that make them feel more organic.

CUSTOMISING BIPED

The biped's creation tools are very flexible. You can access all your parameters, which allow us to adjust not only the poses but also the structure of the biped. If you create a biped and suddenly realise that you require more joints in the fingers, more flexibility in the neck or want to add a ponytail or a tail then you can access the structure's parameters and do the needed.

Biped adjusts the key frames to accommodate the changes you make or even if you add an extra link to the character.

FOOT STEP CREATION & OPERATION ROLLOUT

The footstep creation rollout, available on the motion panel when footstep mode is on, provides controls for creating and editing footsteps. Create a walk, run or jump footstep pattern using these controls.

Once footsteps are formed on the Footstep Creation rollout, use parameters on the Footstep Operations rollout to activate and deactivate footsteps and to adjust the footstep path.

Free form Animation

In Free Form Animation, the biped is animated with complete free form techniques. There are no footsteps in this type of animation. It is appropriate when a biped's feet are always moving and never planted.

IK Blend

As you all know that in Forward Kinematics (FK) a parent object is animated and the child object follows, Whereas when you transform a child object the parent doesn't follow along whereas in Inverse Kinematics (IK) the child object is animated and the parent follows along. You can easily shift between them as well as blend both.

2.9Self-Assessment Test

Broad Questions

1. What is the advantage of using triangular pelvis?
2. What type of animation can be created using the footstep mode?
3. What is free form animation?

Short Notes

a. COM
b. IK Blend
c. Footstep Creation Rollout
d. The anatomy of the Biped
e. Footstep Operation Rollout

2.10 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy

2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov

3. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese

4. Animation with character studio 3, Michele Bousquet

5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Create various Bipeds with varying Free form Animations.

Unit 3 Physique and its Sub Objects

Learning Outcome

After going through this unit, you will be able to:

- State the meaning of Physique modifier
- Use Physique modifier
- Enumerate various Sub objects of Physique modifier
- Explain vertex sub object and its use
- Discuss links sub object and their use
- Show bulge sub object and its use
- Elucidate on envelope sub object and its use
- Elaborate on tendons sub object and its use

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

3.8 Summary

3.9 Self-Assessment Test

3.10 Further Reading

3.1 Introduction to Physique Modifier

In this unit,you will learn how to use character studio's physique modifier to deform a model using biped skeleton.

By assigning a model's control points, CV's for Nurbssurfaces or vertices for Patch and Polygonal Geometry to another object, such as bone,youcan do it because it has to bend or move like real skin.

When you apply Physique to an object, it creates a series of orange interconnected splines called links, which are divided at each joint in the chain. Physique uses the following nature of splines to create smooth realistic deformation.

Typically, physique also creates a spherical (elliptical) bounding volume called envelope. Envelopes are attached to each link to determine its influence on the vertices around it.

The amount of influence is referred to as weight and it defines how closely a given point on the object's surface will follow the link as it deforms.

3.2 Using Physique

Adding the physique modifier to the modifier stack does not actually affect the model at all. For physique to affect the geometry,you need to assign it to the hierarchy and tell it how to estimate the vertex assignments. This step is called Initialisation.

3.2.1 Initialising Physique

With the physique initialisation dialog, you control the parameters used to define the physique'sinitial settings, which determine the type of the deformation applied to the model.

There are several rollouts with customisable parameters but when you apply the first physique modifier,you only need to be concerned with the settings under the Vertex-Link assignment rollout.

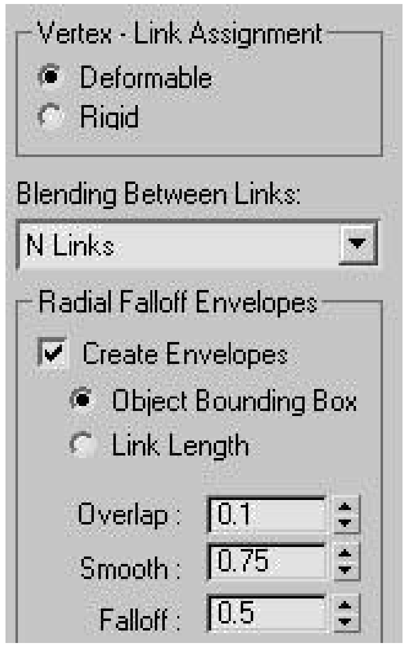

Fig. 3.1: Vertex – Link Assignment Rollout

Study Notes

Assessment

1. When you apply the physique to an object, it creates a series of interconnected splines called links. Which colour is displayed during this process?
2. Explain which shape of the bounding volume is called an envelope when created by physique?

Discussion

Create a biped, fit it on mesh and apply physique.

3.3 Vertex Link Assignment

Vertex – Link Assignment controls the type of deformation, rigid or deformable, applied to all links in hierarchy.

Deformable: Creates deformable envelopes for the links.

Deformable envelopes control vertex-link assignment based on the deformation spline that Physique creates across the links.

Rigid: Creates rigid envelopes for the links.

Rigid envelopes determine vertex-link assignment based upon the linear links in the hierarchy.

Blending Between Links: This drop-down list lets you choose how links are initially:

- N Links: Vertices are influenced by all overlapping envelopes.
- No Blending: Vertices are influenced by only one (1) link. This featureletsa mesh with the Physique modifier applied in character studio 1 to work with character studio 3. Choose No Blending if you are developing characters for a game engine that does not support blending or if you intend to use strictly character studio 1-style vertex-link assignments.
- Two, three or four Links: Vertices are influenced by more than one link, but the number of links is limited to 2, 3 or 4, depending on your choice. Choose one of these options if you are developing characters for a game engine whose support of blending is limited.

Radial Falloff Envelopes Group

Create Envelopes: When it is on, creates envelopes for the links. When this option is off, envelopes are not created.

- Object Bounding Box: Envelope size is based on the size of objects in the hierarchy, such as biped limbs or bones.
- Link Length: Each envelope has a Radial Scale that is one-third of the length of the link. Overlap: This option sets how far the envelopes overlap each other.

Smooth: This option decides the distance between the inner and outer bounds of an envelope by scaling the outer boundary.

Falloff: This option decides the rate of reduction between the inner and outer boundary of an envelope. The falloff rate is a Bezier function.

PHYSIQUE INITIALISATION

The Physique Initialisation dialog is used to specify link parameters and the type and size of envelopes to create for Physique links. This dialog is displayed under two circumstances:

- When you apply Physique initially for the first, using Attach to Node on the Physique rollout on the Modify panel
- When you click Reinitialise on the Physique rollout

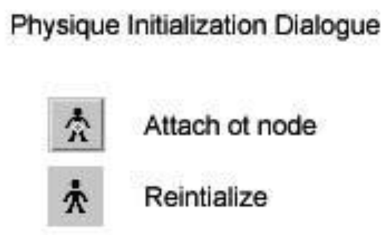

Fig. 3.2: Option Available in Physique Initialisation Dialogue

Study Notes

Assessment

1. Give the extension to save a physique file.
2. Which envelops are stiff attempting to follow the bone closely?

Discussion

Apply Rigid physique on a biped character.

3.4 Link Sub-Object

When a joint in the skeleton bends or rotates, Physique modifier, by default, deforms vertices uniformly on either side of a joint. You can change these default settings by using the tools at the Link sub-object level. For example, you can change the amount of skin slide that occurs along a limb as the limb bends or change the angle of the crease between the upper arm and chest.

3.4.1 Link Settings

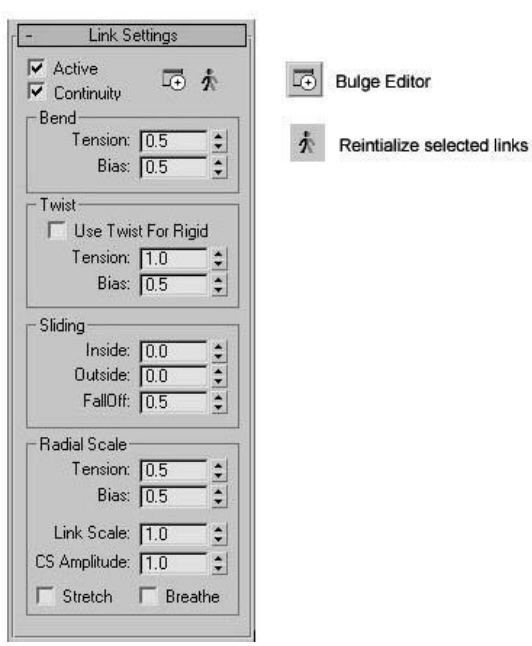

Fig. 3.3: Link Setting Rollout

Controls on the Link Settings rollout let you adjust the behaviour of the selected link.

Active: When on, activates the selected link.

Continuity: This option preserves a smooth transition across the joint from the parent link to the current link.

Bulge Editor: The Bulge Editor displays bulge cross sections schematically, letting you create and edit bulge controls.

Reinitialise Selected Links: This option reinitialises all links and its vertex parameters based on the current link parameter settings.

3.4.2 Bend

Tension: Sets the smoothness of a joint. Tension affects the curvature of the deformation spline through the joint.

Bias: Displaces the pivot point about which vertices are bent.

3.4.3 Twist

Twist parameters control the way the skin deforms when a joint rotates along its length, as in turning a doorknob.

Use Twist for Rigid: When on, twist is used for rigid as well as deformable envelopes.

Tension: Concentrates the effect closer to the joint / moves the effect away from the joint.

Bias: Shifts the distribution of the twist from one side of the joint to the other.

3.4.4 Sliding

Skin sliding parameters influence the amount of skin sliding that occurs when a joint rotates. Without skin sliding, vertices closest to the joint have a tendency to compress on the inside and stretch apart on the outside, generally revealing the segments of the mesh.

Outside sliding affects the vertices around the joint to move toward the joint, blocking localised stretching on the side that is greater than 180 degrees.

Inside sliding affects the vertices to relax and slip away from the joint, blocking bunching of vertices on the side having an angle less than 180 degrees.

Inside: As this value increases, skin moves away from the joint.

Outside: As this value increases, skin moves toward the joint.

Falloff: As this value increases, the result is localised to the joint.

3.4.5 Radial Scale

Radial Scale parameters inflate or reduce the skin by scaling the radial distance perpendicular to the link.

Tension: Values between 0.0 and 1.0 concentrate the effect closer to the joint.

Bias: Shifts the effect of radial scaling. At the default value of 0.5, scaling influences both the selected link and the child link.

Link Scale: This scales the entire link radially, autonomous of the effect of any cross sections.

CS Amplitude: Cross section amplitude has no effect unless the link has bulge angle cross sections.

Stretch: When on, preserves the volume of the link's skin when the length of the link changes.

Breathe: When on, scaling a skeleton node changes the radial scale of the link's skin. When off, scaling a node has no effect on the scale of the skin

3.4.6 Joint Intersections

When a joint bends, the skin can "collide". If collision detection is not done, it can overlap unrealistically. This is particularly likely when one or both of the links have bulges. The joint intersection controllers can detect skin collisions and correct intersection by creasing the skin.

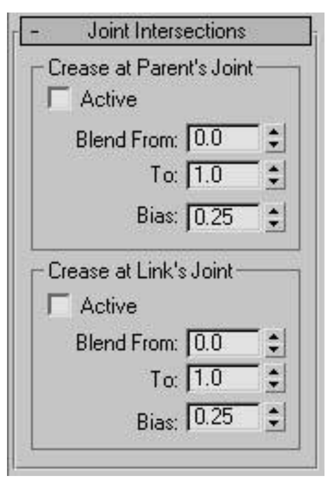

Fig. 3.4: Joint Intersection

The parent’s joint is betweenthe selected link and its parent. The parent’s joint is numbered 0.

The link’s joint is betweenthe selected link and its child. The link’s joint is numbered 1.

Active: Turns off the outcomes of the joint intersection controls. When this box is cleared, Physique makes no reparation for overlapping bulges.

Blend From: theregion between Blend From and Blend To contains vertices that are partly affected by the crease plane. These vertices will be moved, but not as much as those betweenthe crease plane and the point where this joint initiates to blend (Blend From in the parent's case, Blend To in the link's case).

Blend To: Indicates the distance beyond which the crease plane has no effect.

Bias: Sets the strength of the crease plane effect within the blended region.

3.4.7 CROSS SECTIONS

The screen shot of Cross-Sections is given below:

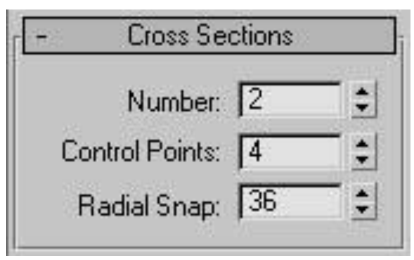

Fig. 3.5: Cross Section Rollout

The options of Cross Section rollout are explained below:

Number: Sets the initial number of cross sections per link.

Control Points: Sets the initial number of control points per cross section.

Radial Snap: Sets the initial number of snap positions per cross section.

	Study Notes

	Assessment

1. Which two options do you get in Joint intersection?
2. Twist propertycomes in _______________.

	Discussion

Create biped character and apply physique with Link settings.

3.5 Bulge sub-object

The various options of Bulge Sub-object are explained below:

Link: Turn on to select links in the view ports. The Copy, Paste and Mirror commands are enabled for links.

Cross Section: Turn on to select and edit cross sections in order to "bulge" the mesh. The Insert, Delete, Copy, Paste and Mirror commands are enabled for cross sections.

Control Point: Turn on to edit cross section control points.

Previous and Next: Click to select the next or previous link, cross section or control point, depending on the selection level.

Bulge Editor: Click to display the Bulge Editor, which lets you create and edit bulge angles using the schematic Cross Section and Profile views

Select Nearest Bulge Angle: Turn on to select the bulge angle nearest to the current joint angle.

Entire Link: This choice in the Current Bulge Angle drop-down list selects all cross sections for all bulge angles in the active link.

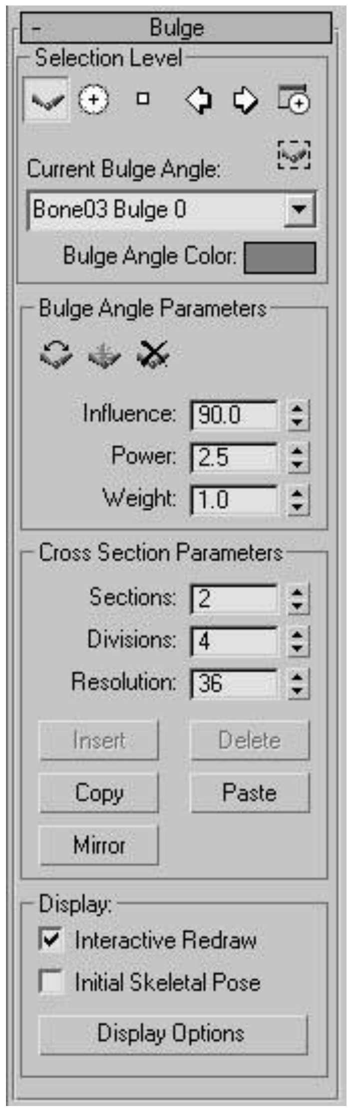

Fig. 3.6: Bulge Rollout

Bulge Angle Colour: Click the colour swatch to change the colour of the current bulge angle.

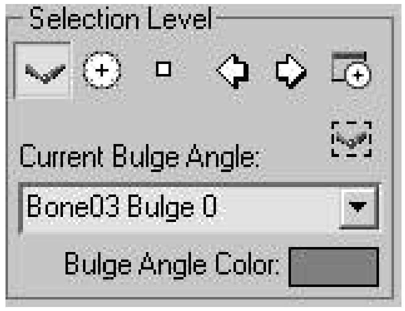

Fig. 3.7: Selection Level Rollout

3.5.1 Bulge Angle Parameters

Various parameters of Bulge Angle are explained below:

Set Bulge Angle: Changes the angle value to the skeleton's current joint angle on the current bulge angle

Insert Bulge Angle: Adds a new bulge angle for the selected link

Delete Bulge Angle: Removes the current bulge angle from the selected link

Influence: The range of angles through which the bulge influences the skin

Power: Controls how smoothly or abruptly the bulge takes effect

Weight: Increases the effect of the current bulge angle relative to the effect of any other bulges.

3.5.2 Cross Section Parameters

The various parameters of cross-section are explained below:

Sections: Sets the number of cross sections for the selected link.

Divisions: Sets the number of control points around the cross section.

Resolution: Sets the number of radial divisions around the cross section.

Insert: Creates a new cross section or control point.

Delete: Deletes the active cross section or control point.

Copy: Copies the active link (with its bulge angles) or cross section.

Paste: Pastes a link (with its bulge angles) or cross section.

Mirror: Mirrors bulge angles and cross sections on bulge angles.

Display window includes the following:

Interactive Redraw: Tur n on to deform the mesh in real time while you edit cross sections in the view ports.

Initial Skeletal Pose: Wh en on, puts the mesh into its original pose, i. e. the pose it was in when Physique was first a pplied

Display Options: Click t o display the Bulge Angle Display Properties dialog, which letsyou customise the view port display of bulges.

3.5.3 Bulge Angle Display Properties

This dialog lets you cust mise how Physique displays bulge angles at t he Bulge sub-object level.

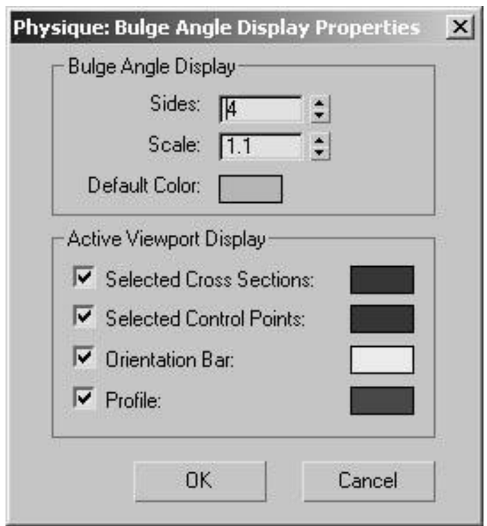

Fig. 3.8: Bulge Angle Display Properties Rollout

Bulge Angle Display

Sides: Specifies the number of sides the bulge angle envelope displays in the view ports.

Scale: Specifies the scale of envelope display in the view ports.

Default Colour: Click to change the bulge angle envelope colour in view ports.

Active View Port Display

Selected Cross Sections: The check box toggles the display of selected cr oss sections.

Selected Control Points: The check box toggles the display of selected c ontrol points.

Orientation Bar: The check box toggles the display of the orientation bar.

Profile: The check box toggles the display of the profile.

3.5.4 BULGE EDITOR

Creating and editing cros s-sections allowyou to "bulge" the mesh. The Bulge Editor is a substitute to using the Bulge s ub-object level to create and edit bulge angles. The change is that the Bulge Editor allows you to create, select and edit cross-sections in graphic Cross Section and Profile views.

By using the Bulge sub- object level, creating and editing of bulge angles is done in the view ports. All the changes in parameters that you make in the Bulge Editor are also reflected on the mesh in the vie w ports.

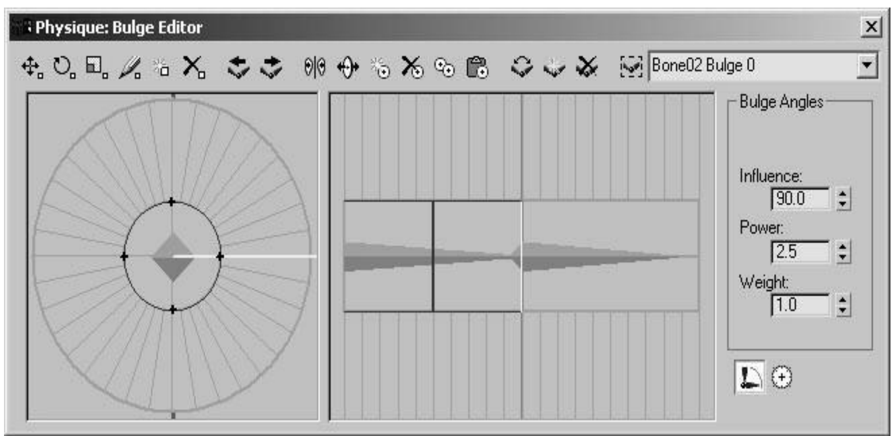

Fig. 3.9: Bulge Editor Dialogue

Select, Scale and Rotate Control Points: Let you select, scale and rotate control points of a cross section in the Cross Section view.

Select and Rotate Cont rol Points: Let you select and rotate control points in and around the centre of the link in Cross Section view.

Select and Scale Control Points: Let you select and scale control poi nts about the link's centre in the Cross Section view.

Draw Control Points: Lets youadd control points by drawing freehan d in the Cross Section view.

Insert Control Points: Letsyou insert control points by clicking the cross section in the Cross Section view.

Delete Control Points: Deletes control points.

Previous Link and Next Link: Move to the next or previous link in the hierarchy. The Cross Section and Profile views update to display the appropriate bulge geometry.

Mirror Selected CS: Mirrors the cross section across the vertical plane running between the green profile reference points at the top and bottom of Cross Section view

Select and Translate CS: Let you select and move a cross section along its link. The bulge on the mesh migrates up and down the link as the cross section is moved.

Insert Cross Section Slice: Lets you insert a cross section by clicking Profile view in the location you want the cross section to appear

Delete Cross Section Slice: Deletes the currently selected cross section

Copy Selected CS: Copies the selected cross section

Paste Selected CS: Pastes copied cross section parameters onto another cross section

Set Bulge Angle: Associates the effect of the current bulge angle with the skeleton's current joint angle

Insert Bulge Angle: Adds a new bulge angle for the selected link

Delete Bulge Angle: Deletes the current bulge angle. The current bulge angle displays in the Current Bulge Angle field.

Select nearest Bulge Angle: When on, selects the bulge angle nearest to the current joint angle

Current Bulge Angle field and drop-down list: Display the current bulge angle

Cross Section View: Cross Section view shows an outline of the operating cross section. In Profile view, the operating cross section is shown in a bright red colour. In Cross Section view, you can control cross sections to bulge the mesh.

Gray Square at centre: Represents the link at the centre of the cross section

Control points: When unselected, are shown as small black crosses on the control spline

Resolution lines: Display as gray lines that surround the link radially

Red line: The control spline for the active cross section

Green line: Represents actual mesh deformation

Orientation bar: Profile view always displays a vertical shape of Cross Section view, denoted by the green dots at the top and bottom of the view, just outside the circle that contains the resolution lines

PROFILE VIEW

Profile view is used to select, move and copy cross sections on the selected link and its child. Highlight a cross section in Profile view to show and edit it in Cross Section view. Profile view is a graphic profile of two links. The presently selected link is on the left and its child link is on the right. If the chosen link is an end link, the outline of the right half of the Profile view turns grey.

Cross sections are displayed as vertical bars across the profile. The operating cross section is red. Unselected cross sections are white. Cross sections that are chosen but not active are dark red.

Profile view displays anoutline of the bulges you create. As in Cross Section view, the main spline is red and the distortion spline is green.

The profile is always a vertical outline of the Cross Section view. You can pull the orientation bar in Cross Section dialog to change the angle of the profile.

To add a new cross section, turn on 'Create CS Slice' and then choose Profile view to set where the cross sectionshould be created.

You can use the Draw tool in Profile view to modify the control spline by freehand drawing. Drawing updates the cross section shapes.

BULGE ANGLES

There are two panels at the right of the Bulge Editor for setting parameters. Use the Bulge Angles panel to change bulge settings for the now active bulge angle.

Bulge Angles: Click on this option to display the Bulge Angles panel.

Influence: This specifies the range of angles through which the bulge influences the skin.

Power: This optioninfluences how smoothly or abruptly the bulge takes effect.

Weight: This option boosts the effect of the current bulge angle comparative to the effect of any other bulges.

There are two panels at the right of the Bulge Editor for setting parameters. Use the Cross Sections panel to alter the cross section settings for a link.

Cross Sections: Choose this option to display the Cross Sections panel.

Sections: This option sets the number of cross sections for the highlighted link.

Divisions: This option sets the number of control points on the highlighted cross sections.

Resolution: This option sets the number of radial divisions over the cross section. Control points snap to the nearest resolution line.

Entire Link: When this option is on, it selects all cross sections for all bulge angles in the highlighted link. Use this to change parameters globally for all cross sections on a link.

Study Notes

Assessment

1. How many options are there In a Bulge angle parameter?
2. Profile view is used to select, move and copy cross sections on the selected link and its child. (True or False)

	Discussion
Practice various options on Physique Bulge Editor.	

3.6 Envelope

Envelope is a primary tool to control skin deformation in Physique. Envelopes describe an area of impact about a single link in the hierarchy and can be set to overlay adjacent links. Vertices that fall in the overlay area of the envelopes are weighed to create smooth blending at joint intersections. Each envelope includes a pair of inner and outer bounds, each with four cross sections.

There are two types of envelopes: deformable and rigid.

- Deformable envelopes affect vertices they cover to follow the deformation spline formed through the hierarchy. Only the vertices covered by deformable envelopes can be moved by bulge angles or tendons.

- Vertices in a rigid envelope are connected to the node (the bone) and move in afixed relationship to the link. Vertices in a rigid envelope, however, are blended in the overlap area of other envelopes. There is a twist constraint in Link Sub-Object that can be allowed in a rigid envelope. This is the rigid envelope to turn along the length of the link.

Each link has an envelope and the shape of the envelope determines which vertices are affected by the link's movement. An envelope has an inner and an outer bound: outside these bounds, vertices are not affected. Inside these bounds, the envelope's influence is strongest at the inner bound. A Falloff setting lets you control how quickly influence falls as it approaches the outer bound.

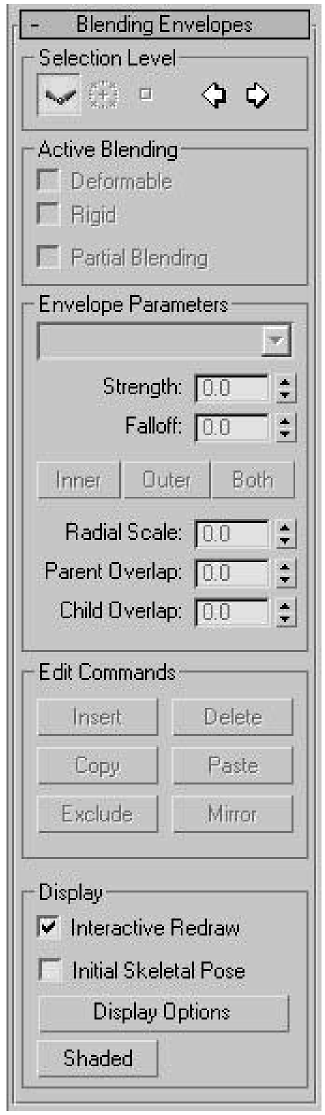

Fig.3.10: Envelop Rollout

Envelopes also control blending:They provide smooth deformation of the skin across joints. Vertices that fall between overlapping envelopes receive influence from each, thus creating a smoothly blended transition. The outer bounds of the envelopes of adjacent links should overlap enough to provide a smooth blend at the joints. You can adjust the relative strength of envelopes, giving one link's envelope more influence than the other.

At the Envelope sub-object level, in addition to the settings already mentioned, you can adjust an envelope's Radial Scale.

The goal is to modify the envelopes so each vertex in the mesh is encompassed by at least one link's envelope.

Usually the first modification is to assign a rigid envelope to the character's head. A rigid envelope mixes with other envelopes but holds the shape of the mesh. The head should not deform with the deformation spline.

These are some frequently encountered problems with the default vertex assignment:

- Vertices that do not follow the skeleton

  To correct this, increase the Radial Scale of an envelope's outer boundary.

- Vertices at joints get pushed or dented in

  Too many envelopes might be affecting these vertices. Try reducing the Radial Scale of the inner bound and reduce the Overlap values of the links on both sides of the joint.

- Bending appears too linear or broken at the joint

  Increase the envelope’s outer Overlap value toward the link on the other side of the joint.

3.6.1 Selection Level

Link: Turn on to select links in the view ports and edit the selected link's envelope parameters.

Cross Section: Turn on to edit envelope cross sections, changing the envelope's shape and thus its area of influence.

Control Point: Turn on to edit the control points on a cross section.

Previous and Next: Click to move to the next or previous link, cross section or control point, depending on which selection level is active.

3.6.2 Active Blending

Deformable: When on, enables a deformable envelope for the selected links

Rigid: When on, enables a rigid envelope for the selected links

Partial Blending: Turns on partial blending for the selected links

3.6.3 Envelope Parameters

Envelope type drop-down list: Shows the type of selected envelope

Strength: Changes the strength of the envelopes. Strength applies to both the inner and outer envelope bounds.

Falloff: Changes the rate of falloff between the inner and outer bounds of an envelope. This is a Bezier curve function.

Inner: Turn on to change the values of the inner bound.

Outer: Turn on to change the values of the outer bound.

Both: Turn on to change the values for both inner and outer bounds at the same time.

Radial Scale: Radially scales the envelope bounds

Parent Overlap: Changes the envelope's overlap with the parent link in the hierarchy

Child Overlap: Changes the envelope's overlap with the child link in the hierarchy

3.6.4 EDIT COMMANDS

The various edit commands are explained below:

Insert: Inserts a cross section or control point on a cross section

Delete: Deletes a cross section or control point

Copy: Copies an envelope or cross section

Paste: Pastes an envelope or cross section

Exclude: You can exclude a link from influencing another link.

Mirror: Mirrors the envelopes on a selected link or mirrors selected cross sections in an envelope

Display

Interactive Redraw: When on, Physique dynamically updates the mesh while the user adjusts envelopes.

Initial Skeletal Pose: When on, puts the mesh character in the pose it was in just before Physique was applied

Display Options: Clicking this button displays the Blending Envelope Display Options dialog, which let you customise envelope display.

Shaded: Toggles shaded display of vertex weights in the view ports

Use Envelope sub-objects to adjust the way skin behaves. Each link has an envelope and the shape of the envelope determines which vertices are affected by the link's movement. An envelope has an inner and an outer bound: outside these bounds, vertices are not affected. Inside these bounds, the envelope's influence is strongest at the inner bound. A Falloff setting lets you control how quickly influence falls as it approaches the outer bound.

Envelopes also control blending. They provide smooth deformation of the skin across joints. Vertices that fall between overlapping envelopes receive influence from each, thus creating a smoothly blended transition. The outer bounds of the envelopes of adjacent links should overlap enough to provide a smooth blend at the joints. You can adjust the relative strength of envelopes, giving one link's envelope more influence than the other does.

At the Envelope sub-object level, in addition to the settings already mentioned, you can adjust an envelope's Radial Scale. This is useful for making sure the envelope encloses vertices along the length of the link. The settings for Strength, Falloff, Radial Scale and Overlap are grouped under Envelope Parameters.

Envelopes have cross sections. You can add cross sections to refine the shape of an envelope and you can move or scale a cross section's control points to change the cross section's shape.

3.6.5 Workflow

The goal is to modify the envelopes so each vertex in the mesh is encompassed by at least one link's envelope.

Usually the first modification is to assign a rigid envelope to the character's head. A rigid envelope merges with other envelopes but retains the shape of the mesh. The head should not deform with the deformation spline.

With Initial Skeletal Pose turned on, test that the envelopes confine all areas of the mesh. If you turn off Initial Skeletal Pose, the character assumes its animated position at the current frame. Use an animation that stretches the character around, such as a run or dance motion. Find a frame where the envelopes needaltering and edit the envelope parameters. Altering the envelopes with the character in an animated position will always reference the Initial Skeletal Pose.

These are some frequently encountered problems with the default vertex assignment:

- Vertices do not follow the skeleton.
- Vertices at joints are pushed or dented in.
- Bending appears too linear or broken at the joint.

Link: Turn on to select links in the viewports and edit the selected link's envelope parameters.

Cross Section: Turn on to edit envelope cross sections, changing the envelope's shape and thus its area of influence.

Control Point: Turn on to edit the control points on a cross section.

Previous and Next: Click to move to the next or previous link, cross section or control point, depending on which selection level is active.

Deformable: When on, enables a deformable envelope for the selected links

Rigid: When on, enables a rigid envelope for the selected links

Partial Blending: Turns on partial blending for the selected links

Envelope type drop-down list: Shows the type of the selected envelope

Strength: Changes the strength of the envelopes

Falloff: Changes the rate of falloff between the inner and outer bounds of an envelope. This is a Bezier curve function.

Inner: Turn on to change the values of the inner bound.

Outer: Turn on to change the values of the outer bound.

Both: Turn on to change the values for both inner and outer bounds at the same time.

Radial Scale: Radially scales the envelope bounds, Range=0.0 to 100.0, Default=1.0

Parent Overlap: Changes the envelope's overlap with the parent link in the hierarchy

Child Overlap: Changes the envelope's overlap with the child link in the hierarchy

Insert: Inserts a cross section or control point on a cross section

Delete: Deletes a cross section or control point

Copy: Copies an envelope or cross section

Paste: Pastes an envelope or cross section

Exclude: Clicking this button displays the Exclude Envelopes dialog. You can exclude a link from influencing another link.

Mirror: Mirrors the envelopes on a selected link or mirrors selected cross sections in an envelope

Interactive Redraw: Wh en on, Physique dynamically updates the me sh while you adjust envelopes.

Initial Skeletal Pose: W hen on, puts the mesh character in the pose it was in just before Physique was applied

Display Options: Clicking this button displays the Blending Envelope Display Options dialog, which lets you customise envelope display

Shaded: Toggles shaded display of vertex weights in the view ports

3.6.6 BLENDING ENVELOPE DISPLAY OP TIONS DIALOG

The blending Envelope Display options dialog box is shown below:

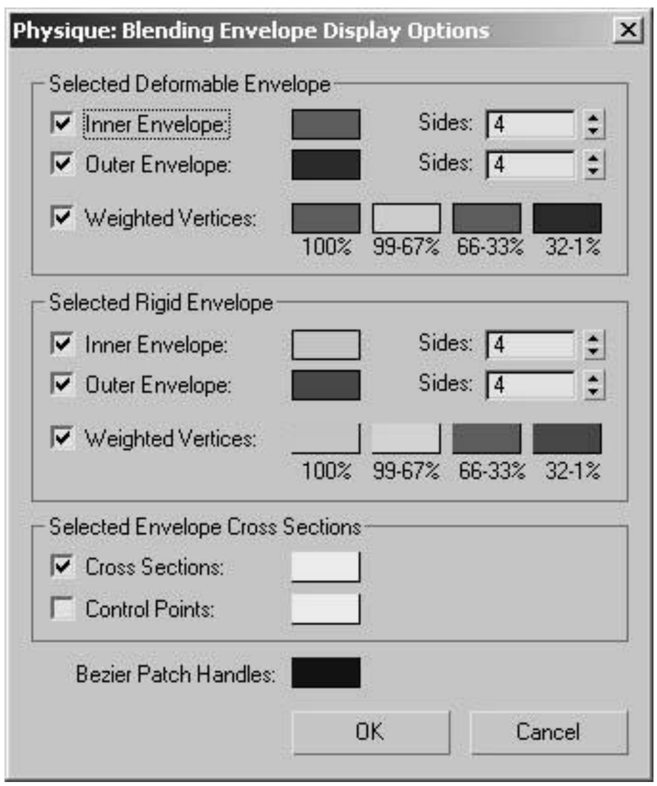

Fig. 3.11: Blending Envelope Display Options

Selected Deformable Envelope andSelected Rigid Envelope Groups

These two groups have the same controls. By default, deformable e nvelopes are shown in red and rigid envelopes are shown in green.

Inner Envelope: The check box toggles view port display of inner envelopes. Click the colour swatch to change the view port colour of the inner envelope boundary.

Sides: Sets the number of inner envelope sides shown in the view port display.

Outer Envelope: The check box toggles view port display of outer envelopes. Click the colour swatch to change the view port colours of the outer envelope boundary.

Sides: Sets the number of outer envelope sides shown in the view port display.

Weighted Vertices: The check box toggles view port display of weighted vertices. Click a colour swatch to change view port colours of weighted vertices in a particular percentage range.

Selected Envelope Cross Sections Group

Cross Sections: Toggles view port display of cross sections. Click the colour swatch to change the view port colour of selected cross sections.

Control Points: Toggles view port display of control points. Click the colour swatch to change the view port colour of selected control points.

Bezier Patch Handles: Click to set the view port colour of Bezier patch handles.

Study Notes

Assessment

1. How many types of envelopes are there in Character Studio?
2. Envelopes are a primary tool to control skin deformation in____________.

	Discussion
Work with envelop while biped connect with mesh.	

3.7 Tendons

This dialog box lets you customise how Physique displays tendons at the Tendons sub-object level.

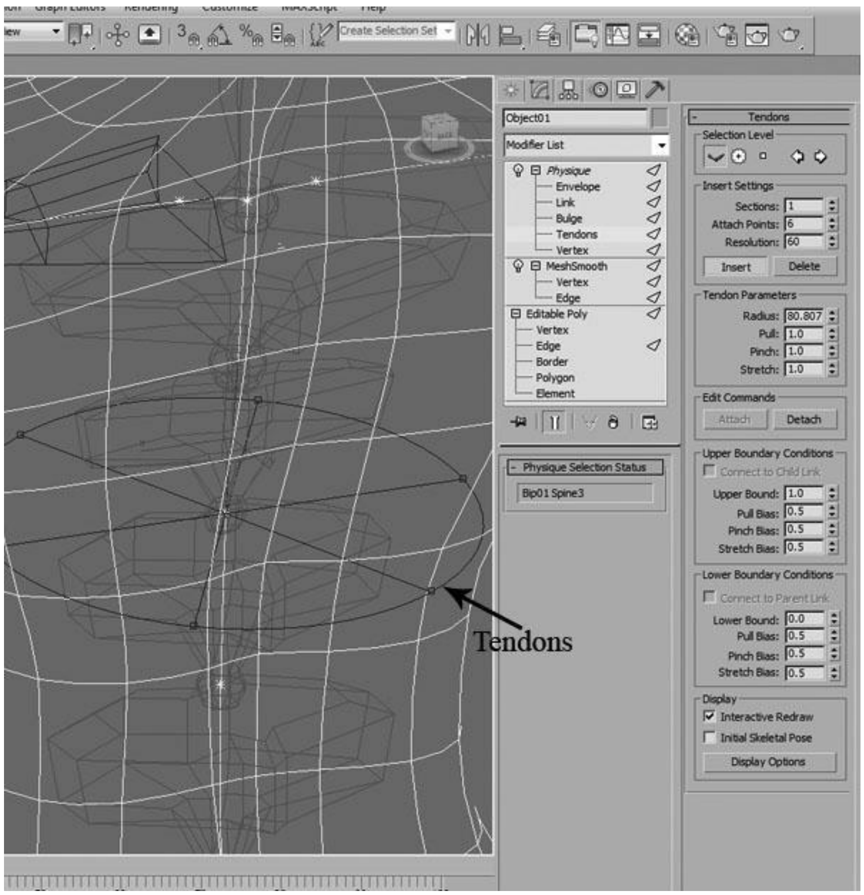

Fig. 3.12: Tendons

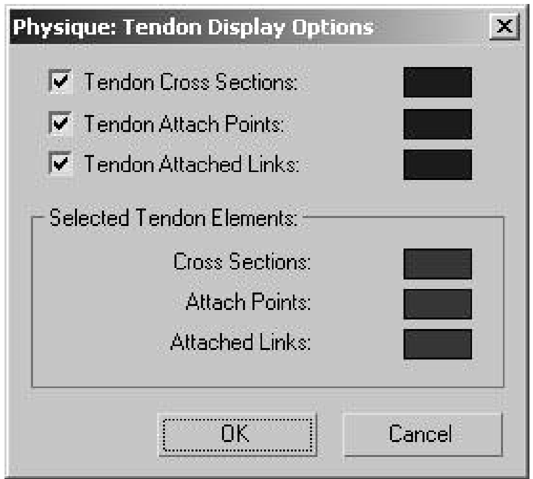

Fig. 3. 13: Tendon Display Option Rollout

The various options of Tendon display option rollout are explained belo w:

Tendon Cross Sections: The check box toggles the display of tendon cro ss sections.

Tendon Attach Points: T he check box toggles the display of tendon atta ch points.

Tendon Attached Links: The check box toggles the display of attached li nks. Selected Tendon Elements

Cross Sections: Click to c hange the view port colour of selected cross se ction.

Attach Points: Click to change the view port colour of selected attach po ints.

Attached Links: Click to change the view port colour of selected attache d links.

Study Notes

	Assessment
1. When are tendons used? 2. ____________option is used to set the number of attach points that are added around each of the crosses.(Sections/Attach points)	

	Discussion
Use Tendons while working with physique.	

3.8 Summary

INTRODUCTION TO PHYSIQUE MODIFIER

In this unit,you learned how to use character studio's physique modifier to deform a model using biped skeleton. When you apply Physique to an object, it creates a series of interconnected splines called links, which are divided at each joint in the chain. Physique uses the following nature of splines to create smooth realistic deformation.

USING PHYSIQUE

Adding the physique modifier to the modifier stack does not actually affect the model at all. For physique to affect the geometry,you need to assign it to the hierarchy and tell it how to estimate the vertex assignments. This step is called Initialisation.

VERTEX LINK ASSIGNMENT

There are several rollouts with customisable parameters but when you apply the first physique modifier,you only need to be concerned with the settings under the Vertex-Link assignment rollout. Vertex – Link Assignment controls the type of deformation, rigid or deformable, applied to all links in hierarchy. Use the Physique Initialisation dialog to indicate link parameters and the type and size of envelopes to create for Physique links.

LINK SUB-OBJECT

When a joint in the skeleton bends or rotates, Physique, by default, deforms vertices uniformly on either side of a joint. You can modify these defaults by working on the tools at the Link sub-object level. Skin sliding parameters influence the amount of skin sliding that occurs when a joint rotates. Without skin sliding, vertices closest to the joint have a tendency to compress on the inside and stretch apart on the outside, generally revealing the segments of the mesh.

BULGE

Physique makes a single bulge angle for each bulge joint in the attached skeleton. The angle of this joint is that of the initial skeleton pose. Creating and editing cross-sections let you to "bulge" the mesh. The Bulge Editor is a substitute to using the Bulge sub-object level to create and edit bulge angles. The change is that the Bulge Editor allows you to create, select and edit cross-sections in graphic Cross Section and Profile views.

Profile view is used to select, move and copy cross sections on the selected link and its child. Highlight a cross section in Profile view to show and edit it in Cross Section view. Profile view is a graphic profile of two links. The presently selected link is on the left and its child link is on the right. If the chosen link is an end link, the outline of the right half of the Profile view turns grey.

With Initial Skeletal Pose turned on, test that the envelopes confine all areas of the mesh. If you turn off Initial Skeletal Pose, the character assumes its animated position at the current frame. Use an animation that stretches the character around, such as a run or dance motion. Find a frame where the envelopes need altering and edit the envelope parameters. Altering the envelopes with the character in an animated position will always reference the Initial Skeletal Pose.

ENVELOPE

Envelopes are a primary tool to control skin deformation in Physique. Envelopes mark an area of impact about a single link in the hierarchy and can be set to overlap adjacent links. Vertices that are covered in the overlap area of the envelopes are weighted to make smooth blending at joint intersections. Each envelope contains a pair of inner and outer bounds, each with four cross sections.

Envelopes also control blending: they provide smooth deformation of the skin across joints. Vertices that fall between overlapping envelopes receive influence from each, thus creating a smoothly blended transition. The outer bounds of the envelopes of adjacent links should overlap enough to provide a smooth blend at the joints. You can adjust the relative strength of envelopes, giving one link's envelope more influence than the other.

3.9 Self-Assessment Test

Broad Questions

1. What is Physique?
2. What are the different sub objects of the Physique modifier?
3. What is the use of Bulge Sub Object?

    a. Physique modifier
    b. Link Sub-object
    c. Bulge Sub-object
    d. Vertex Sub-object
    e. Envelope Sub-object
    f. Tendons Sub-object

3.10Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
4. Animation with character studio 3, Michele Bousquet
5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Fit Biped into a modelled character and then apply Physique to combine Biped with model geometry. Use various sub-objects of Physique to make the skin deformation look natural.

CHARACTER ANIMATION

BCADES-208

BLOCK 2:

ANIMATION &
MOTION CAPTURE

Dr. Babasaheb Ambedkar Open University, Ahmedabad

“Education is something which ought to be brought within the reach of every one.”

- Dr. B. R. Ambedkar

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Chharodi, Ahmedabd-382481

Dr. Babasaheb Ambedkar

Open University

BCADES-208

CHARACTER ANIMATION

Block

2

ANIMATION & MOTION CAPTURE

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The content is developed by taking reference of online and print publications that are mentioned in Bibliography. The content developed represents the breadth of research excellence in this multidisciplinary academic field. Some of the information, illustrations and examples are taken "as is" and as available in the references mentioned in Bibliography for academic purpose and better understanding by learner.'

ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

Unit 1 Foot Step Animation

Learning Outcome

After going through this unit, you will be able to:

- Explain the Footstep mode
- Create Footsteps for the biped
- Design Walk Footsteps
- Create Run Footsteps
- Create Jump Footsteps
- Discuss Footstep method and editing

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

4.1 Introduction to Footstep Animation

4.2 Footstep Mode

4.3 Footstep Creation Rollout

4.1 Introduction to Footstep Animation

Biped's patented footstep-driven key frame animation feature allows animators to use footsteps to create broad, global brush strokes for character movement. Once footsteps are in place, key frames are generated automatically to produce an initial sketch of the 3D character's motion. Throughout edits and revisions, the original property of the character is preserved. Biped remembers everything about how a character moves and it makes all of the appropriate adjustments if the footsteps are changed.

4.2 Footstep Mode

When Footstep mode is functioning, you can create or edit footsteps to produce a walk, run and jump footstep pattern. You can also edit chosen footsteps in space and attach footsteps using parameters available in Footstep mode.

If footsteps are separated during motion capture import, turn on Footstep mode to edit footsteps in the view ports.

A powerful feature in Biped is the ability to adjust key frames when footsteps are edited in space or time. The following tracks are affected in the area when a footstep is edited in space:

- Body Horizontal keys convert to step or hop within range of new footstep locations.
- Body Vertical keys convert to match possible changes in stride length, since the body must be lower in order to step longer distances.
- Body Rotation keys convert to bank into turns created by changes in path curvature or body speed.
- Right or left leg keys in a move state must be changed to step between new locations.
- Two other rollouts display when Footstep mode is active:

  Footstep Creation rollout

  Footstep Operations rollout

Study Notes

Assessment

1. Explain briefly the steps for footstep mode factions.
2. State True/False. A powerful feature in Biped is the ability to adjust key frames when footsteps are edited in space or time.

Discussion

Apply Footsteps and work with its properties.

4.3 Footstep Creation Rollout

The Footstep Creation rollout, available on the Motion panel when Footstep mode is on, provides controls for creating and editing footsteps. Create a walk, run or jump footstep pattern using these controls.

Fig 4.1 Footstep Creation Rollout

Create Footsteps: Turn on Create Footstep mode.

Create Footsteps: Create footsteps at the current frame.

Create Multiple Footsteps: Create a walk, run or jump footstep pattern automatically.

Walk: Sets the biped gait to Walk.

Run: Sets the biped gait to Run.

Jump: Sets the biped gait to Jump.

Walk Footstep: Specifies the number of frames a new footstep will be on the ground during a walk.

Double Support: Specifies the number of frames when both feet will be on the ground at the same time during a walk.

Run Footstep: Specifies the number of frames a new footstep will be on the ground during a run.

Airborne: Specifies the number of frames when the body will be in the air during a run or a jump.

2 Feet Down: Specifies the number of frames when two sequential footsteps, on opposite sides, will be on the ground during a jump.

Study Notes

	Assessment

1. Where do you get Footstep Creation rollout?
2. ________________ specifi es the number of frames a new footstep will be on the ground during a run. (Walk/ Run)

	Discussion

Create Footstep with biped and work with Footstep creation rollout in detail.

4.4 Create Multiple Fo otsteps Dialog: Walk / Run / Jump

The Create Multiple Footsteps dialog for the walk / run / jump g ait creates a sequence of walking footsteps using a series of parameters.

This dialog box is displayed when you select the walk / run / jump gait o n the Motion panel's Footstep Creation rollout, then click Create Multiple Footsteps

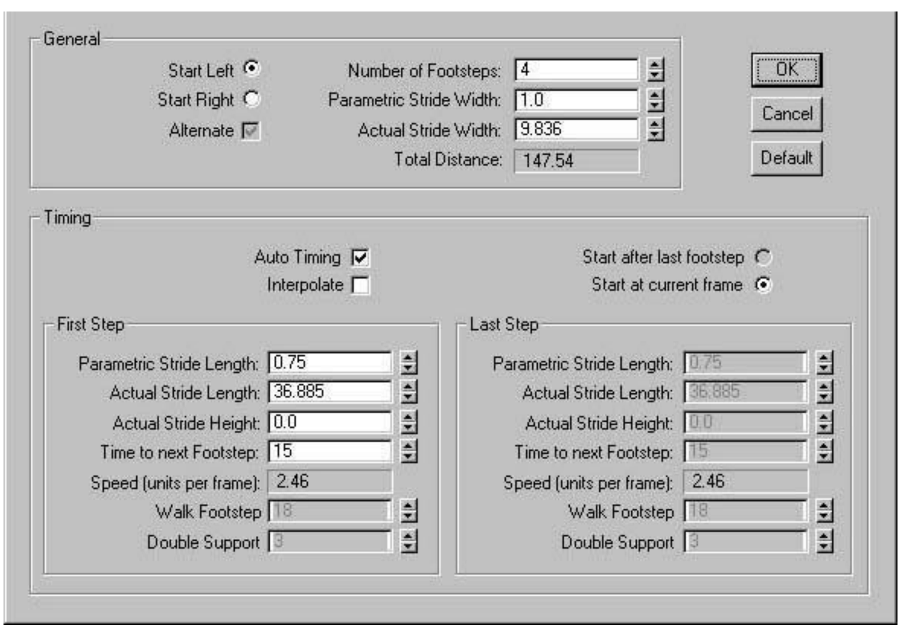

Fig. 4.2: Create Multiple Footstep Mode

Start Left: Starts the footstep sequence with a left step.

Start Right: Starts the footstep sequence with a right step.

Alternate: Footsteps will alternate between right and left.

Number of Footsteps: Determines the number of new footsteps to be created.

Parametric Stride Width: Sets the stride width as a percentage of the pelvis width.

Actual Stride Width: Sets the stride width in modelling units.

Total Distance: Displays the total distance the footsteps will travel with the current settings.

Default: Resets the values on the dialog to default values.

Auto Timing: Sets timing parameters automatically.

Interpolate: Control acceleration or deceleration of the series of footsteps.

Start after Last Footstep: Appends the newly created footsteps to the end of the existing footstep sequence.

Start at Current Frame: This option implants the newly created footsteps at the current frame after the present footstep sequence, allowing you to make a gap in time before the footsteps start again.

Parametric Stride Length:This option sets the step length for the new footsteps as a percentage of the length of the biped's leg.

Actual Stride Length:This option sets the step length for new footsteps in max units.

Actual Stride Height:This option sets the rise or fall between footsteps.

Time to Next Footstep:This specifies the number of frames in each foot movement cycle. This is only enabled if Auto Timing is on.

Speed:This displays the number of units the biped will move per frame. It changes in response to variations in the other parameters but cannot be adjusted directly.

Walk Footstep:This specifies the number of frames each footstep will be on the ground during a walk.

Double Support:This specifies the number of frames both feet will be on the ground at the same time during a walk.

	Study Notes

	Assessment
1. From where do you get multiple footstep dialog? 2. Speed is the number of units the biped will move per frame. (True/False)	

	Discussion
Create multiple footsteps.	

4.5 Footstep Operations Rollout

Once footsteps are generated through the Footstep Creation rollout, use parameters on the Footstep Operations rollout to activate and deactivate footsteps and to alter the footstep path.

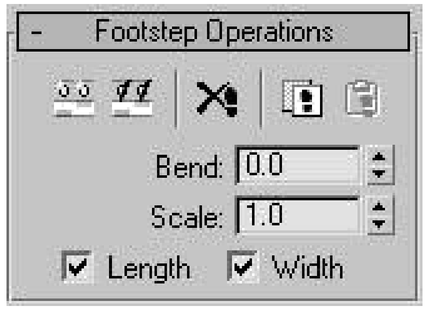

Fig. 4.3: Footstep operations rollout

Create Keys for Inactive Footsteps:This activates all inactive footsteps.

Deactivate Footsteps:This removes the body keys assigned to the select ed footsteps, making those footsteps inactive.

Delete Footsteps:This option deletes the selected footsteps.

Copy Footsteps:This opt ion copies the selected footsteps and biped keys to the footstep buffer.

Paste Footsteps:This option pastes footsteps from the footstep buffer in to a scene.

The footsteps emerge in active in the scene. Move them so that the y overlap the active footsteps. When a footst ep changes into red colour, move mouse up a nd the pasted footsteps will activate.

Bend:This option bends the path for the selected footsteps. The path is twisted to the left or right as you move the spinner.

Other footsteps followi ng the selected footsteps will be moved to retain their positions relative to the relocated footsteps.

Scale:This option changes the width or length for the selected fo otsteps. The particular footsteps are scaled a round the first footstep in the selection.

Length: When Length is selected, the Scale spinner alters the step length of the selected footsteps. Length and W idth may both be active at the same time.

Width: When Width is selected, Scale changes the step width of the selected footsteps. Length and Width ma y both be active at the same time.

	Study Notes

	Assessment

1. What bends the path for the selected footsteps?
2. Deactivate Footsteps removes the body keys assigned to the selected footsteps, makingthose footsteps inactive.(True / False)

	Discussion

Work with Footstep operation rollout.

4.6 Working with Footstep Animation

Footsteps are a central compositional tool in Biped. Footsteps are biped sub-objects, similar to gizmos in max. In view ports, footsteps appearance isas the diagrams often used to clarify ballroom dancing. Each footstep's position and angle in the scene controls the biped steps.

Fig. 4.4: Footstep Animation

Study Notes

Assessment
1. Footsteps are a central compositional tool in Biped. (True / False) 2. Each footstep's position and angle in the scene controls where the___________ steps.

	Discussion
Work with Footstep Animation.	

4.7 Footstep Method

In view ports, footsteps represent support periods in space for the biped feet. You can move and rotate footsteps in view ports. In Track View, each footstep shows as a block that denotes a support period in time for each of the biped's feet. You can move footsteps in time in Track View. The footstep position and orientation in the view port controls where the biped will step.

There are three ways to create footsteps for the biped:

- Place footsteps individually.
- The footstep tools can be used to automatically generate a walking, running or jumping animation.
- Import motion-capture data to footsteps.

A key advantage of the footstep system is the natural adaptation of the biped that occurs when the footsteps are edited in time and space. Editing footsteps in the view ports allows you to reposition all of the footsteps to move the entire animation. In Footstep mode, step, length, width and direction can be changed quickly for an entire animation and the biped automatically adapts.

Using the Footsteps Show/Hide button on the Display rollout, all footsteps can become visible. Move the footsteps in the view ports to position them for proper ground collision with the terrain object. For example, if the biped toes are rotated for the Lift key at the last frame of a footstep (to create more toe curl as the character walks), the leg automatically repositions itself to maintain foot contact with the ground (footstep).

These changes speed up the process of creating and editing animation for the biped. If necessary, the animator can avoid biped adaptation by using the Adapt Locks parameters on the Dynamics & Adaptation rollout.

	Study Notes

	Assessment
1. In how many different ways can footsteps be created? 2. Where can you move the footstep in time?	

	Discussion/Activity
Apply Footsteps method in footstep animation.	

4.8 Foot States

There can be four-foot states in footstep animation: move, touch, plant and lift. These resemble the state of the biped feet in relationship to the footsteps. Use the foot state displays in the Biped rollout to regulate the state of the biped feet when you are editing the biped foot or leg keys. The foot states can be displayed in the view port by turning on Leg states in the Display group of the expanded Biped rollout. The Foot states are represented as colour keys in Track View - Dope Sheet.

	Study Notes

	Assessment

1. Which are the four-foot states in footstep animation?
2. The foot states can be displayed in the view port by turning on Leg states in the Display group of the expanded Biped rollout. (True / False)

	Discussion

Practice Foot states with proper examples.

4.9 Footstep Editing

At any point in the design process, you can decide to interactively edit your footstep's spatial pattern in the scene or the timing of footsteps in Track View. The key-frames adapt each edit: alterations to footstep location retain the details of all your key frame positions. Key frame timing remains synchronized with changes to footstep timing, except in cases where default leg keys must be regenerated to account for timing edits that alter the basic gait pattern, such as creating a hop in the middle of a walk.

Use Footstep mode to create and edit footsteps. Use Key frame mode (Footstep mode off) to create and edit your character's keys. You can always edit the timing of both footsteps and key frames in Track View.

While the biped's feet are mid-air, you can animate its legs as you do its upper body. Biped does not produce keys based on physics while the biped is off the ground, so animating the legs might be necessary to make long leaps realistic. You might need to make the biped appear to be floating in mid-air instead or underwater or have it ride a bicycle.

You can make the biped interact with other objects in the scene also, like throwing or kicking a ball, opening a door and so on. You do this by linking a biped limb to an object in the scene.

An animation enabled IK Blend parameter let you store the anchored position and combine inverse with forward kinematics. Remove the anchors once keys have been set.

Tip: You can frequently get good results by loading an existing biped motion and then varying it.

Study Notes

Assessment

1. Which mode do you have to use to create and edit footsteps?
2. Biped does not produce keys based on physics while the biped is off the ground, so animating the legs might be necessary to make long leaps realistic.(True / False)

Discussion
Create footstep and try footstep editing.

4.10 Summary

Introduction to Footstep animation

In this session,you learned how to use character studio’s Footstep animation. Biped's patented footstep-driven key frame animation feature allows animators to use footsteps to create broad, global brush strokes for character movement. Once footsteps are in place, key frames are generated automatically to produce an initial sketch of the 3D character's motion. Biped remembers everything about how a character moves and it makes all of the appropriate adjustments if the footsteps are changed.

Footstep mode

When Footstep mode is active, you can generate or edit footsteps to generate a walk, run and jump footstep pattern. You can also edit chosen footsteps in space and attach footsteps using parameters available in Footstep mode. If footsteps are separated during motion capture import, turn on Footstep mode to edit footsteps in the view ports. A powerful feature in Biped is the ability to adjust key frames when footsteps are edited in space or time.

Footstep creation rollout

The Create Multiple Footsteps dialog for the walk / run / jump gait creates a sequence of walking footsteps using a series of parameters. When you select the walk / run / jump gait on the Motion panel's Footstep Creation rollout a dialogue box will open up, where you can change various settings related to the creation of Footsteps.

Once footsteps are created through the Footstep Creation rollout, use parameters on the Footstep Operations rollout to activate and deactivate footsteps and to adjust the footstep path and direction.

Footsteps are a central compositional tool in Biped. Footsteps are biped sub-objects, similar to gizmos in max. Each footstep's position and orientation in the scene influences where the biped steps.You can move and rotate footsteps in view ports. In Track View, each footstep shows as a block that represents a support period in time for each of the biped's feet.

At any point in the design process, you can decide to interactively edit your footstep's spatial pattern in the scene or the timing of footsteps in Track View. Using the Footsteps Show/Hide button on the Display rollout, all footsteps can become visible. Move the footsteps in the view ports to position them for proper ground collision with the terrain object.

4.11Self-Assessment Test

Broad Questions

1. What options are available in the footstep mode?
2. For which actions the footsteps can be created?
3. How to edit the footsteps created for the biped?

Short Notes

a. Footstep mode
b. Multiple footstep dialog
c. Footstep method
d. Foot states
e. Editing footsteps

4.12Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese

Assignment

Create a Biped and animate it using various Footstep animations.

Unit 2 Balance Factor

Learning Outcome

After going through this unit, you will be able to:

- Define the balance factor
- Change the balance factor as per the requirement of your animation
- Specify air borne dynamics
- Identify the effect of gravity on the biped
- Practise prop or extra body parts animation
- Explain ballistic tension

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

5.1 Introduction to Balance Factor

5.2 Gravitational Acceleration (Gravaccel)

5.3 Adjusting Vertical Motion

5.4	Airborne Dynamics
5.5	Gravity and Timing
5.6	Understanding Biped Anatomy
5.7	Changing the Biped Hierarchy
5.8	Repositioning Biped Body Parts
5.9	Props
5.10	Adding Extra Biped Body Parts
5.11	Timing And Foot States Display
5.12	Adapt Locks
5.13	Shifting The Biped's Balance
5.14	Rubber-Banding the COM
5.15	Ballistic Tension
5.16	Animated Pivot Points
5.17	Summary
5.18	Self-Assessment Test
5.19	Further Reading

5.1 Introduction to Balance Factor

When you bend at the w aist, your hips may or may not shift backwards depending on what else is happening.

Example: When you ben d forward to pick up an object, your hips shift backwards to compensate for the weight of the shoulders in front of your body. If you try to bend over without shifting your hips backw ard there will be too much weight in front and you will fall over.

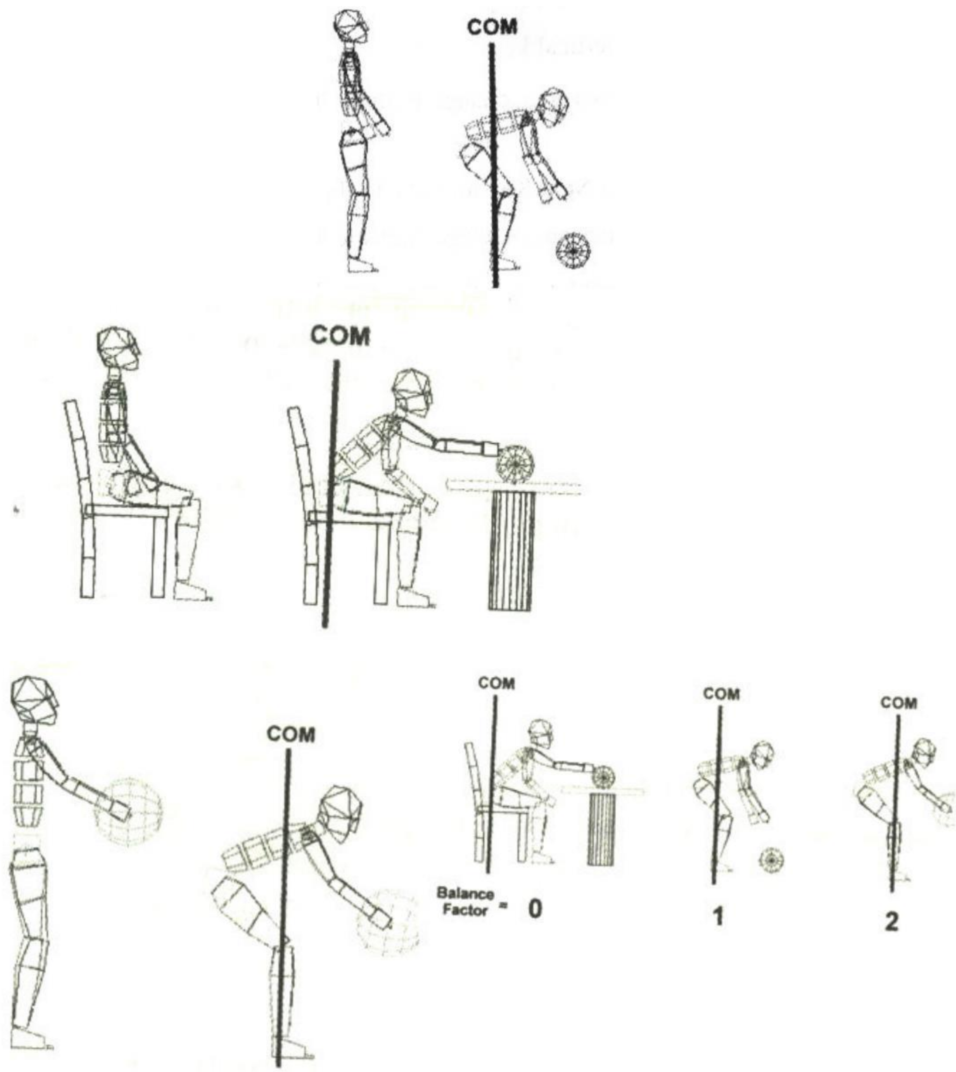

Fig. 5.1: Displaying Balance Factor Adjustments

The effects of different balance factors are best seen with a bipe d that bends forward or backward at the wais t. The balance factor should be changed before the biped is animated with bending motions. Changing the balance factor after the biped has already been animated has a still effect. The balance factor can be animated.

The Balance Factor parameter can have any value from 0 to 2:

- When Balance Factor is 1 (the default value) and you rotate the spine forward, both the hips and head swing out from their original vertical alignment to a similar degree to compensate for the shift in weight. This value is suitable for times when the biped leans forward while standing.

- When Balance Factor is 0 and you rotate the spine forward, the COM keeps its original vertical alignment and the head swings forward. There is no movement in the hips to compensate for the shift in body weight. This setting is good for animating a sitting biped who leans forward, to prevent its hips from shifting backward. It can also work well for characters with tails; the tail provides weight in back of the biped, so the hips do not have to shift backward to compensate when the character bends over.

- When Balance Factor is 2 and you rotate the spine forward, the head retains its original vertical alignment while the COM swings backward. The hips compensate strongly for the shift in body weight. This setting can be useful for violent or acrobatic motions.

5.2 Gravitational Acceleration (Gravaccel)

In footstep animation, the GravAccel (for gravitational acceleration) parameter lets you scale the height of airborne periods. The greater this value, the greater the height. If the biped appears to be going too high, reduce this value; if the biped goes too low, increase it. Each biped has its own Gravitational Acceleration value. The default is based on the height of the biped.

For example, if feet are the active 3ds max units and the biped is about 5 feet 10 inches tall, then Gravitational Acceleration equals 32, for 32 ft. per second. For other biped heights, character studio would scale this value to naturalistically fit the scene. The Gravitational Acceleration value also changes to agree with other unit systems, such as metric.

GravAccel is located on the Dynamics & Adaptation rollout.

	Study Notes

	Assessment

1. GravAccel Stands for ______________.
2. GravAccel is located on the_____________.

	Discussion

Practice the given example in the topic.

5.3 Adjusting Vertical Motion

A ballistic gait is any footstep pattern in which there are periods with no feet on the ground, causing the biped to become airborne or ballistic. Running and jumping are ballistic gaits, while walking is not.

When Biped Dynamics is turned on in the Dynamics & Adaptation rollout and you activate footsteps, the Body Vertical keys that are automatically generated during a ballistic gait period will take gravity and landing speed into account. The parameters described in this section affect Body Vertical keys created in this manner.

	Study Notes

	Assessment
Running and jumping are ballistic gaits, while walking is not. A ballistic gait is any footstep pattern. (True/False)	

	Discussion
Animate biped and use adjusting vertical motion.	

5.4 Airborne Dynamics

With footsteps, each airborne period always begins and ends with Body Horizontal and Body Vertical keys. These keys define the position of the biped at lift-off and touchdown.

When the biped is airborne and Biped Dynamics is turned on, the vertical motion is governed by physically based dynamics. Its airborne trajectory is based on the current gravity setting, the height of the Body, Vertical key at lift-off and touchdown and the amount of time in the air.

By default, there is no Body Vertical key at the peak of the biped's trajectory; the biped's peak airborne height is calculated and enforced automatically. Of course, some of your characters will not be at the same height as the average person, so airborne periods between footsteps for these characters will appear inaccurate, with the biped jumping too high or too low for your purposes.

There are two solutions to this problem. You can change the amount of time the character is airborne between footstepsor you can accelerate gravity with the GravAccel parameter.

Study Notes

Assessment

1. When does theairborne period begin?
2. When the biped is airborne and Biped Dynamics is turned on, the vertical motion is governed by physically based dynamics. (True/False)

Discussion

Create footstep animation in different heights and make its inaccurate appearance airborne between two footsteps.

5.5 Gravity and Timing

In reality, the length of time a person, animal or insect stays in the air during a jump is based on two factors:

- How high the creature jumps, which in turn is based on how hard the creature pushes with its legs at the start of the jump. The creature's weight has no bearing on the height of the jump, except to affect its ability to give a good push at the start. A very light character might be taken by the wind and thus stay in the air longer, but that circumstance is not part of the gravitational equation.
- The gravitational pull of the planet from which the creature jumps.

From these two factors, you can calculate how long the creature will stay in the air. You can also perform this calculation backward; if you know how long the creature was in the air and the gravitational equation for the planet, you can figure out how high it jumped.

Study Notes

Assessment

1. The length of time a person stays in the air during a jump is based on two factors. Name them.
2. The length of time a person, animal or insect stays in the air during a jump is based on ____ factors.(True/False)

	Discussion
Create a jump of a biped and use Gravity and its timing.	

5.6 Understanding Biped Anatomy

The geometry of a biped is a connected hierarchy of objects that by default look like those of a human. The root object of the biped is its Center of Mass (COM). This object is shown as a blue octahedron near the center of the biped's pelvis. You can select the COM by choosing Bip01 from the Select by Name dialog as well as you can also select the COM by clicking Body Horizontal, Body Vertical or Body Rotation in the Track Selection Rollout.

	Study Notes

	Assessment
1. The root object of the biped is its Center of Mass. (True / False) 2. While moving the COM, which part of the biped will move?	

	Discussion
Create biped and study Center of Mass for freeform animation.	

5.7 Changing the Biped Hierarchy

The biped Hierarchy is slight different than a standard 3ds max hierarchy in that you can't delete any of the components of the skeleton. If you try to delete any portion of the biped skeleton, you delete the entire hierarchy. If you want to create a partial biped, say, a biped with no head, simply hide the objects you do not want to use.

	Study Notes

	Assessment
1. What will happen if you delete any portion of a biped? 2. List the steps necessary to create a partial biped, i.e. a biped with no head.	

	Discussion
Create a Biped without one hand.	

5.8 Repositioning Biped Body Parts

Certain Biped body parts can be moved in Figure mode to suit different characters. You can move complete arm assemblies by selecting the clavicles and moving them up or down. You can also shift the fingers, tail and ponytails as you like.

Biped's construction also includes an option to add forearm twist. This uses two to four forearm links to assign twisting animation into the biped's associated mesh via Physique or Skin.

Study Notes

Assessment

1. You can move complete arm assemblies by selecting the clavicles and moving them up or down. (True / False)
2. Which option(s) can be included in biped constructions?

Discussion

Create biped and shift the fingers, tail and ponytails.

5.9 Props

The biped structure now includes an option to add up to three props. Props appear next to the biped's hands and body by default, but can be modified or animated throughout the scene like any 3ds max object.

5.10 Adding Extra Biped Body Parts

To add more legs, arms or other body parts you want to create 3ds max geometry for those parts and then link them to the biped hierarchy. You can use Snapshot to copy biped body parts to produce these as well. In some cases, you will need to animate them with regular 3ds max rotations, because biped IK will not be available on these extra parts.

Study Notes

Assessment

1. Props appear as boxes in the biped hierarchy. (True / False)
2. Biped IK will be available on these extra body parts. (True / False)

Discussion

Create biped and try animation with prop. Later, add extra body parts in Biped.

5.11 Timing and Foot States Display

The footstep is a special kind of key spanning several frames. In the track view, each footstep key is displayed as a colour block rather than dot.

When keys are created for inactive footsteps, keys are also generated for the entire body based on the footstep timing and physical placement.

The first and the last frames of the footsteps are given special consideration during this process. Keys for COM and legs are always generated at the first and last frames of each footstep in addition to any other keys required for motion.

If the biped is airborne the COM keys at the first and the last frames of each take-off and landing footstep appear as red dots in the track view indicating that keys cannot be moved individually.

The only way to move a red key is to move the complete footstep. This is because the individual frames of a footstep key are not all treated the same way as the various states for the footstep frames have names. The states are as follows:

Touch: First frame of a footstep when the foot touches down

Plant: All frames between the TOUCH and LIFT states.

Lift: Last frame of footstep when the foot is about to exit the footstep.

Move: Move frame where there is no footstep key.

The footsteps always follow this sequence: Touch-Plant-Lift-Move

Study Notes

Assessment

1. Explain a footstep in one line.
2. All frames between the TOUCH and LIFT states _________. (plant/lift/move)

Discussion

Create biped animation and use timing and foot states.

5.12 Adapt Locks

When you move or rotate footsteps after keys have been created for them, the keys for legs and the COM are adapted accordingly.

Lock specified tracks to prevent automatic adjustments being made to those tracks when footsteps are moved in space or edited in time. All the locks except for Time work for footstep editing in space. Time locks upper body keys when footsteps are edited in time (Track View). Adapt Locks only applies to a Footstep animation, not a freeform animation.

When you move a footstep in space or adjust footstep timing, Biped automatically adapts existing key frames to match the new footsteps. Adapt locks allows you to preserve the exact position of already created keys for a selected track.

Adapt Locks does not need to be on all the time. For example, if you want to raise all the footsteps along the world Z-axis, without changing the upper body position, turn on Footstep Adapt Locks group > Body Vertical Keys, turn on Footstep mode, select all the footsteps and move them up along the world Z-axis.

The footsteps are repositioned, the legs are adapted, but the upper body retains the same motion rather than being raised with the footsteps. Now turn off Body Vertical Keys and the upper body retains its original motion.

Body Horizontal Keys: Turn on to prevent adaptation of body horizontal keys when footsteps are edited in space.

Body Vertical Keys: Turn on to prevent adaptation of body vertical keys when footsteps are edited in space.

Body Turning Keys: Turn on to prevent adaptation of body turning keys when footsteps are edited in space.

Right Leg Move Keys: Turn on to prevent adaptation of right leg move keys (a leg move key, is a leg key between footsteps) when footsteps are edited in space.

Left Leg Move Keys: Turn on to prevent adaptation of left leg move keys (a leg move key, is a leg key between footsteps) when footsteps are edited in space.

Freeform Keys: Turn on to prevent adaptation of a freeform period in a footstep animation. The biped's position during a freeform period will not move if footsteps after the freeform period are moved further away.

Time: Turn on to prevent adaptation of upper body keys when footstep duration is changed in Track View.

Study Notes

Assessment

1. Adapt Locks only applies to a Footstep animation, not a freeform animation. (True / False)
2. Turn on ____________________to prevent adaptation of body vertical keys when footsteps are edited in space. Choose one from the bracket. (Body Vertical Keys / Body Turning Keys)

Discussion

When you move or rotate footsteps after keys have been created for them, the keys for legs and the COM are adapted accordingly. Try it in your animation.

5.13 Shifting the Biped's Balance

After footsteps are activated, you can adjust the biped's overall balance in either of two ways:

- In the Biped rollout, turn on Rubber Band Mode and move the biped's COM or
- Change or animate the Balance Factor parameter in the Key Info rollout.

Study Notes

Assessment

Fill in the blanks.

After footsteps are activated, you can adjust the biped's overall balance in either of two ways:

- In the Biped rollout, turn on _____________________Mode and move the biped's COM or
- Change or animate the _____________________ parameter in the Key Info rollout.

Discussion
Create biped animation and shift the biped’s balance.

5.14 Rubber-Banding the COM

When Rubber Band mode is active, you can move the biped's center of mass in relation to the rest of the body, changing the biped's overall balance. Rubber banding the center of mass defines your character's balance point in at-rest pose and in any resulting motion.

When a character is standing at rest, with feet side by side, the center of mass should be directly above the area where the feet touch the ground. The center of mass determines the center of your character's distribution of weight. For most characters, the physical center of mass is located near the pelvis.

Typical placements for the center of mass are:

- Characters that stand erect, such as humanoids, use the default location of the center of mass within the pelvis.
- Characters that naturally lean forward, such as some dinosaurs and birds, should have the center of mass moved slightly forward of the pelvis. This is also good for robots and droid soldiers.
- Characters that are holding a heavy weight out in front of them or overweight characters, might need their center of mass moved slightly forward of the pelvis.
- Characters that are pushing or pulling objects might need their center of mass moved slightly behind the pelvis.

	Study Notes

	Assessment

State True / False.

1. When a character is standing at rest, with feet side by side, the center of mass should be directly above the area where the feet touch the ground.
2. Rubber-banding the center of mass defines your character's balance point in at-rest pose and in any resulting motion.

	Discussion

Create the biped animation and use rubber banding.

5.15 Ballistic Tension

The ballistic tension controls the amount of spring or tension when the biped lands or takes off from a jump or run step.

	Study Notes

	Assessment

1. When will ballistic tension work?
2. ___________________controls the amount of spring or tension when the biped lands or takes off from a jump or run step.

	Discussion

Create Jump of biped and use ballistic tension in it.

5.16 Animated Pivot Points

When a foot steps into a footstep, its pivot point is set to its heel. When the foot is selected, the pivot point appears on the screen as a red dot.

As the foot rolls forward through the footstep, its pivot point moves to the end of its big toe.

These changes to the pivot point are set automatically when footsteps are created. You can also change a foot's pivot point manually to simulate different kinds of movement. In addition to the above, the pivot point can also be animated.

	Study Notes

	Assessment

State True / False.

- You can also change a foot's pivot point manually to simulate different kinds of movement.
- The pivots are only visible and accessible when in Freeform mode.

	Discussion

Create the Biped and animate the pivot point.

5.17 Summary

GRAVITATIONAL ACCELERATION (GRAVACCEL)

In footstep animation, the GravAccel (for gravitational acceleration) parameter letsyou scale the height of airborne periods. The greater this value, the greater the height. If the biped appears to be going too high, reduce this value; if the biped goes too low, increase it.

ADJUSTING VERTICAL MOTION

When Biped Dynamics is turned on in the Dynamics & Adaptation rollout and you activate footsteps, the Body Vertical keys that are automatically generated during a ballistic gait period will take gravity and landing speed into account.

AIRBORNE DYNAMICS

When the biped is airborne and Biped Dynamics is turned on, the vertical motion is governed by physically based dynamics. Its airborne trajectory is based on the current gravity setting, the height of the Body Vertical key at lift-off and touchdown and the amount of time in the air.

GRAVITY AND TIMING

Length of time a person or creature stays in the air during a jump is based on 2 factors:

How high the creature jumps, which in turn is based on how hard the creature pushes with its legs at the start of the jump

The gravitational pull of the planet from which the creature jumps

UNDERSTANDING BIPED ANATOMY

The geometry of a biped is a connected hierarchy of objects that by default look like those of a human. The root object of the biped is its Centre of Mass (COM).

CHANGING THE BIPED HIERARCHY

The biped Hierarchy is slight different than a standard 3ds max hierarchy in that you can’t delete any of the components of the skeleton. If you try to delete any portion of the biped skeleton, you delete the entire hierarchy.

Repositioning biped body parts

Certain Biped body parts can be moved in Figure mode to suit different characters. You can move complete arm assemblies by selecting the clavicles and moving them up or down. You can also shift the fingers, tail and ponytails as you like

Props

Props appear next to the biped's hands and body by default, but can be modified or animated throughout the scene like any 3ds max object.

Adding extra biped body parts

To add more legs, arms or other body parts you need to create 3ds max geometry for those parts and then link them to the biped hierarchy. You can use Snapshot to copy biped body parts to produce these as well.

Timing and foot states display

If the biped is airborne, the COM keys at the first and the last frames of each take-off and landing footstep appear as red dots in the track view indicating that keys cannot be moved individually. The only way to move a red key is to move the complete footstep.

Adapt locks

Adapt Locks only applies to a Footstep animation, not a freeform animation. Adapt locks allows us to preserve the exact position of already created keys for a selected track.

Shifting the biped's balance

After footsteps are activated, you can adjust the biped's overall balance in either of two ways:

In the Biped rollout, turn on Rubber Band Mode and move the biped's COM or Change or animate the Balance Factor parameter in the Key Info rollout.

Rubber-banding the COM

Rubber-banding the centre of mass defines the character's balance point in at-rest pose and in any resulting motion.

Ballistic tension

This controls the amount of spring or tension when the biped lands or takes off from a jump or run step.

Changes to the pivot point are set automatically when footsteps are created. You can also change a foot's pivot point manually to simulate different kinds of movement. In addition, the pivot point can be animated.

5.18Self-Assessment Test

Broad Questions

1. What is Balance Factor? How does it affect the animation?
2. Can you change the hierarchy of the biped?
3. What is air borne time?

Short Notes

a. Gravitational acceleration
b. Airborne dynamics
c. Timing and foot states
d. Adapt locks
e. Ballistic tension

5.19Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Use Balance Factor to create more realistic freeform animation.

Unit 3 Motion Capture and Motion Flow

Learning Outcome

After going through this unit, you will be able to:

- Explain Motion Capture
- Enumerate Motion Capture techniques and devices
- Define Motion Flow
- Exhibit how to generate Random Motions
- Handle Crowd simulations
- Apply transitions between two or more motions

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

6.1 Introduction

Motion capture, motion tracking or mocap are terms used to describe the process of recording movement and translating that movement on to a digital model. It is used in military, entertainment, sports and medical applications and for validation of computer vision and robotics. In filmmaking, it refers to recording actions of human actors and using that information to animate digital character models in 2D or 3D computer animation. When it includes face and fingers or captures subtle expressions, it is often referred to as performance capture.

In this unit, we will study various concepts related to motion capture, which will make this term clearer and easier to understand.

6.2 Motion Capture Data

The process of digitizing the movements of a live “actor” or “talent” is known as Motion Capture, which requires a motion-capture device.

6.2.1 Working With Motion-Capture Data

Motion capture is the way of getting motion data from live actors performing various actions. The motion data is retrieved (captured) via sensors positioned at the actors' joints and extremities.

CS does not perform motion capture, but it takes motion-capture data in the most commonly used formats. This data can be brought into the Character Studio, applied to the biped and used as is or combined with other motions with Motion Flow or the Motion Mixer.

Motion-capture data normally needs some adjustment before it fits your biped or animation perfectly. When motion-capture data is brought into character studio, it can be filtered to:

- Use fewer key frames
- Create footstep motion
- Use props in the scene

In addition to this, some motion-capture files come with a distinct marker file, which can be used to match the biped posture to the motion-capture actor.

6.2.2 How Motion-Capture Data Is Acquired

Motion-capture data is typically acquired by one of several means:

Optical Sensing Technology

Optical systems have become very popular over the last couple of years. These systems can recommend the performer the most freedom of movement since they do not need any cabling. Optical systems integrate directionally reflective balls, referred to as markers thatconnect to the performer.

Optical systems need at least three video cameras, each of which is set with a light source that is aligned to brighten the field of view for that camera. Each camera is in turn linked to a synchronized frame buffer. The computer is displayed with each camera view in order to analyse a 3D position of each marker; the resulting data stream therefore contains of 3D position data for each marker. This data is usually applied to an inverse kinematics system, to animate a skeleton.

Electro-Magnetic Sensing Technology

This is a prevalent method used for performance capture. Magnetic capture contains the use of a centrally located transmitter and a set of receivers that are fastened on to various parts of the performer's body. These receivers are capable of computing their spatial relationship to the transmitter. Each receiver is linked to an interface that can be synchronized to prevent data skew. The resulting data stream comprises of 3D positions and orientations for each receiver. This data is normally applied to an inverse kinematics system to drive an animated skeleton.

This magnetic method shares the same lack of obstruction problems with the audio method, but it also shares the same negative factors, such as the interference of cables, lack of sufficient receivers and the restricted capture area. In addition, being magnetic, the system is influenced by any sizable areas of metal in the vicinity of the capture area, such as girders, posts and so on

Prosthetic Sensing Technology

This is one of the initial methods for capturing the motion from different parts of human anatomy. These methods contain simple "on/off" type of motion-detection systems as well as complex motion-tracking systems.

The later type of prosthetic motion capture would bethe best approach if it were not for the complex mechanical prerequisites and the performance-inhibiting qualities commonly associated with such designs. However, the type of data delivered can be clean, rotational data gathered in real time without any occlusion problems. This method is based on a set of frames that must be attached all over the performer's body.

The frames are then connected to each other by using a sequence of rotational and linear encoders. These encoders are then associated to an interface that can simultaneously read all the encoders in order to avoid data skewing. Ultimately, through a set of trigonometry functions, the performer's motion can be examined. These design constraints seem to be quite difficult to overcome and will probably limit the use of this type of device for character animation.

ACOUSTIC SENSING TECHNOLOGY

Acoustic capture is another way currently used for performance capture. This method involves the use of a triad of audio receivers. An array of audio transmitters is strapped to various parts of the performer's body.

The transmitters are successively triggered to output a "click" and each receiver measures the time it takes for the sound to travel from each transmitter. The computed distance of the three receivers is triangulated to provide a point in 3D space.

A fundamental issue with this approach is the sequential nature of the position data it creates. In general, one would like to see a "snap shot" of the performer's skeletal position rather than a time-skewed data stream. This position data is normally applied to an inverse kinematics system, which in turn drives an animated skeleton.

6.2.3 COMBINING BIP MOTIONS

Character studio offers two main ways of combining BIP files to build more complex character animations.

- Motion flow uses BIP files as clips in a script. The motion-flow script joins clips together using transitions. Transitions can be unconditional, they can be chosen at random or they can be governed by rules such as collision detection. You can control when a transition begins and ends. You can use motion flow to animate a single biped or a crowd of bipeds.

  Motion flow scripts are saved as Motion Flow Editor (MFE) files.

- The Motion Mixer also uses BIP files and MFE files as clips. In addition to creating transitions from one BIP animation to another, over time, Mixer scripts can combine the upper-body movement of o ne biped with the lower-body movement of a nother, adjust the timing of movements and provide a number of other effects.

- The Mixer is especially useful when you work with motion-capture files. Mi xer scripts are saved as BIP files or MIX file s. The method of digitizing the movements of a live “actor” or “talent” requires a motion -capture device.

6.2.4 Motion Capture Conversion Parameters

Motion-capture and marker data usually have keys at every frame. Filtering motion-capture data lessens keys, maki ng the job of altering or personalising the motion data much simpler. Other filtering possib ilities include footstep extraction, applying the skeletal structure stored in the motion-c apture file to the biped, looping the data, importing a piece of the motion-capture file and s electing tracks to load.

- None Freeform: No footsteps are extracted.

For swimming or flying motion d ata, footstep extraction is not necessary.

Fi g. 6.1: Motion Capture Rollout

- On: Extracts footsteps.
- Fit to Existing: Fits to existin g footsteps.
- Conversion: Chooses the type of key processing.
- Use Key Reduction: Reduces keys for simpler key editing.
- No Key Reduction:This doe s not reduce keys. Use this on files that are p reviously key reduced or if you want to wo rk with all the data in a raw motion-capture fil e.
- Load Buffer Only:This does not utilise the data to the biped, but loads the data to the motion-capture buffer only.
- Up Vector:This sets the upri ght axis used in the motion-capture data.
- Scale Factor:This multiplies the saved talent size by this value and sizes the biped accordingly.

6.2.5 Footstep Extraction

The various options, which are active when Footstep Extraction is on, are discussed below:

Extraction Tolerance:This sets the sensitivity of footstep extraction.

Sliding Distance:This creates a sliding footstep when positional tolerance is reached.

Sliding Angle:This option creates a sliding footstep when rotational tolerance is reached.

Only Extract Footsteps Within Tolerance:This option turns on Z -axis Tolerance. These controls screen out footsteps that do not fall within a given range of the ground plane.

Tolerance:This option value is a percentage of leg length.

From Z Level:This set a Z value (ground).

Flatten Footsteps to Z=0:This moves extracted footsteps to Z=0.

6.2.6 Load Frames

The screen shot of Load Frames is given below:

Fig. 6.2: Footstep Load Frames Dialogue

The options displayed in the above screen shot can be detailed as:

Start: Start importing at this frame. Default is frame 0, the first frame.

End: Stop importing at this frame. Default is the last frame of the clip.

Loop: Loop the data by the value set here.

6.2.7 Key Reduction

Key reduction keeps the original motion intact and intelligently filters out more than 80 percent of the keys in the motion-capture file, making the process of altering the biped animation much simpler.

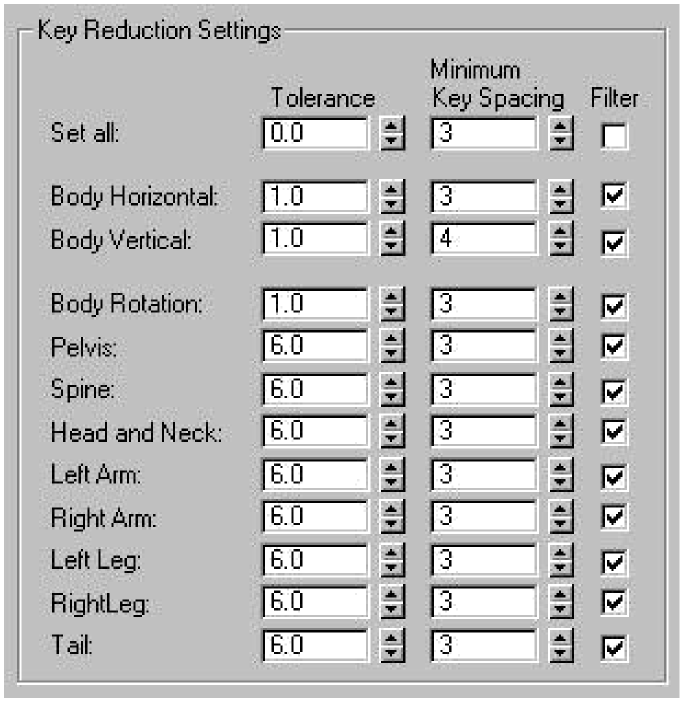

Fig. 6. 3: Key Reduction Settings Dialogue

Use the Tolerance and M inimum Key Spacing settings to fine-tune key reduction for a specific track (body part). Specify whether to filter a track in the Filter column.

These settings are availa ble only if Conversion is set to Use Key Reductio n.

Tolerance: Sets the maximum angular or positional deviation for a track.

Minimum Key Spacing: S ets the minimum number of frames between keys.

Filter: Turn off to prevent filtering of the motion capture data into a track. When this is off, there is no key reduction for the track.

Set All: Forces all tracks t o the values set in these fields.

6.2.8 Limb Orientation

The biped elbow and knee hinge joints are perpendicular to the triangles formed by the shoulder-elbow-wrist and hip-knee-ankle respectively. Resolve errors in the motion-capture data that break this rule by using either the angle or the point method.

Angle: Moves the knee or elbow position to create the biped joint key.

Point: Rotates the shoulder-elbow-wrist or hip-knee-ankle to create t he biped joint key.

Auto: Auto reads exact hand and foot positions from the motion-capture data; character studio then places the knees and elbows in a natural position.

6.2.9 Talent Definition

Loads a Figure Structure File (.fig) and a Pose Adjustment file (.cal) prior to importing a marker file. Typically, you correct a marker file by importing it and adjusting the biped scale and limb positions relative to the markers, then saving a .fig and a .cal file using Save Talent Figure Structure and Save Talent Pose Adjustment on the Motion Capture rollout.

These files can then be loaded in the Talent Definition area when importing marker files created by the same actor in a motion capture session.

Figure Structure: Loads a .fig file.

Pose Adjustment: Loads a .cal file.

Browse: Browses for a .fig or .cal file.

Use: Usealternates both the .fig and .cal files to adjust marker files during a marker file import procedure.

Load Parameters: Loads a motion capture parameter file (.moc)

Save Parameters: Saves a motion capture parameter file (.moc)

6.2.10Motion-Capture Buffer

Any file imported using Load Motion Capture File is stored in its raw (no filtered) form in the motion-capture buffer. This buffer is used to try new filtering options with the Convert from Buffer command and to paste keys from the raw motion-capture data to the biped using Paste from Buffer on the Motion Capture rollout. The Show Buffer command displays a stick figure that represents the buffered data.

You can create your own library of imported and optimized motion-capture data by saving .bip files for use with other characters or as part of a longer script in Motion Flow mode. Use a biped that has no mesh attached to it with Physique. You import the data, adjust it to your liking and save it as a .bip file. You can also run standard .bip files through this filtering process to create loops or to extract footsteps from a freeform animation.

6.2.11Sliding Footsteps

Motion-capture and marker data typically have keys at every frame. Filtering motion-capture data reduces keys, making the job of altering or personalising the motion data much simpler. You can create your own library of imported and optimized motion-capture data by saving .bip files for use with other characters or as part of a longer script in Motion Flow mode. Use a biped that has no mesh attached to it with Physique. You can import the data, adjust it to your liking and save it as a .bip file. You can also run standard .bip files through this filtering process to create loops or to extract footsteps from a freeform animation.

6.2.12 Motion Capture Import

While importing motion capture data,you can import rotation and position type data.

Biovision(.BVH)files have limb and joint rotation data and character studio marker files(.CSM) have position data.

Footstep motion capture is enabled automatically when importing motion capture data using the Sliding Tolerance and Sliding Angle controls in the Motion Capture Conversion Parameters dialog. You can import a file in basic mode of the animation of every frame as well as filtering reduction key.

6.2.13 Footstep Extraction

The following options are active when Footstep Extraction is on during motion capture conversion. These options are:

Extraction Tolerance: Sets the sensitivity of footstep extraction. Character Studio determines if the footstep is there by checking that the foot does not move beyond the distance determined by the Extraction Tolerance value.

Sliding Distance: Creates a sliding footstep when positional tolerance is reached. This value is a percentage of foot length. By default, the foot must slide its own distance (100), before a sliding footstep is created.

Sliding Angle: Creates a sliding footstep when rotational tolerance is reached. This value is in degrees. The default is set high (360 degrees), the foot must make a complete turn before a sliding footstep is created.

Only Extract Footsteps Within Tolerance: Turns on Z-axis Tolerance. These controls filter out footsteps that do not fall within a given range of the ground plane. Use this when filtering motions, such as hopping or pitching a baseball, in which a foot might come off the ground and remain stationary, but its position is not intended as a footstep.

Tolerance: Value is a percentage of leg length.

From Z Level: Set a Z value (ground).

Flatten Footsteps to Z=0: Moves extracted footsteps to Z=0.

Motion-capture and marker data typically have keys at every frame. Filtering motion-capture data reduces keys, simplifying the job of altering or personalising the motion data. Biped let you filter the data of each track with its own filtering settings, so you have control over which nuances of motion you want to pick up without filling the rest of the tracks with unwanted keys. Filtering is done using the Motion Capture Conversion Parameters rollout.

Other filtering options include footstep filtering and extraction, looping the data and importing a portion of the motion-capture file.

Character studio ships with a variety of raw (unfiltered) motion-capture data files, in .bip, .csm and .bvh formats. Some of the same data is available in filtered versions, either with footsteps or freeform. Try your own filtering adjustments on the raw versions of this data. Importing the raw data displays the original motion very accurately when you select Show Buffer on the Motion Capture rollout. Use the Motion Capture buffer as a guide when adjusting and refining the filtered data. Several tools are available in the Motion Capture rollout to aid you in this process.

Create your own library of imported and optimized motion capture data by saving .bip files for use with other characters or as part of a longer script in Motion Flow mode. Use a biped that has no mesh attached with Physique.

Load Motion Capture File: Key reduces and extracts footsteps from raw motion-capture data. Load .bip, .csm or .bvh files.

Set lowest starting foot height to Z=0: Sets the lowest starting foot height to Z=0. This is an option in the Load File dialog. Default=on.

Restructure biped to match file: Turn on to change the biped structure to match the structure stored in the .bip file.

Set lowest starting foot height to Z=0: Sets the lowest starting foot height to Z=0.

.bip: Filters the raw version of the motion-capture data that ships with character studio. These are in a .bip format.

.bvh: BioVision motion-capture data file. Contains the “actor’s” skeletal and motion information.

.csm: Imports a character studio marker file (ASCII format file).

Convert from Buffer: Filters the most recently loaded motion-capture data.

Paste from Buffer: Pastes a frame of raw motion-capture data to the selected parts of the biped.

Show Buffer: Displays raw motion-capture data as a red stick figure.

Show Buffer Trajectory: Displays buffered raw motion-capture data as yellow trajectories for the selected biped body parts.

Batch File Conversion: Converts one or more .csm or .bvh motion-capture files to filtered .bip files. Displays the Motion Capture Batch File Conversion dialog.

Talent Figure Mode: After loading a raw marker file, turn on Talent Figure mode to scale the biped relative to the markers.

Keyframe adaptation takes place in order to accommodate the new biped scale; because of this, you should adjust the biped scale before adjusting the biped position relative to the markers.

Use Rubber Band mode on the Biped rollout and Non-Uniform Scale to size the biped in Talent Figure mode.

Save Talent Figure Structure: After changing the biped scale in Talent Figure mode, you can store the changes into a .fig file.

Adjust Talent Pose: After loading a marker file, use Adjust Talent Pose to correct the biped position relative to the markers.

Save Talent, Pose Adjustment: Saves a Talent Pose adjustment as a .cal file.

Load Marker Name File: Loads a Marker Name (.mnm) file to map incoming marker names in motion-capture files (.bvh or .csm) to the character studio marker naming convention.

Load a CSM marker file: Browses for a marker file for use with a CSM file.

Load a BVH marker file: Browses for a marker file for use with a BVH file.

Use: Uses the marker name file when importing motion capture files

Show Markers: Opens the Marker Display dialog, with settings for specifying how markers are displayed.

	Study Notes

	Assessment

1. How many options are there in motion capture rollout?
2. Explain briefly Load Motion Capture File.

	Discussion

Create dance animation and use Filtering motion capture and marker data.

6.3 Understanding Motion Flow

In Motion Flow mode, you combine BIP files to create longer character animation. You also use motion flow along with crowd animation to automatically generate crowd behaviour.

One motion can transition into another. To generate a transition, character studio uses either velocity-interpolated transitions (“minimum motion loss”) or an algorithm to minimise sliding feet.

Motion Flow is a tool that graphically arranges clips (motion files), flowing from one motion to the next. You can use a Motion Flow graph to set up a series of clips with transitions between them, which will make the biped perform the series of motions in sequence.

You can also create a network of clips on the graph, where each clip has a transition to two or more clips. With this type of graph, you can tell character studio to generate the actual motion sequence for you based on random selection.

A crowd simulation can also be used to generate a motion sequence from this type of graph. Each biped in the crowd chooses from the motions and transitions in the graph based on where they want to go and how fast they need to get there. These factors, in turn, are determined by the crowd parameters you set.

6.3.1 Working with Motion Flow

Motion flow mode provides an area to graphically arrange clips into a network and tools to create and edit transitions between clips. Motion flow mode is used to organise clips into a network to animate one or more bipeds. The network of clips is joined together by transitions. A motion flow script is used to associate the network of clips with the biped. To animate one biped, you create a single motion flow script that uses a list of clips to animate the biped. To animate multiple bipeds or a crowd of bipeds, you can either use the random method of clip selection or a delegate–driven approach.

The random method simply picks clips at random and creates random scripts for each biped. This approach works well if the bipeds are standing still or are far apart and do not require collision detection: For Example, a crowd of cheering fans at a ball game. Clip and transition percentages are set with the Create Random Motion command during motion synthesis.

When dealing with a crowd or multiple bipeds that are close together, the delegate driven approach is the best solution. This approach uses many parameters to simulate moving crowds and incorporates collision detection, surface follow and other parameters. The delegate–driven method uses a network of clips, but instead of random selection. It bases clip selection on a delegate's speed and heading. In a delegate–driven crowd simulation, the clips are arranged to follow a logical sequence. For example, the first clip could be a start walk clip, then a walk loop, then a branch to a turn right and turn left clip, then a slow to stop clip and so on. During motion synthesis, this arrangement is used to pick clips.

If the software senses a collision ahead, the slow to stop clip is selected or a veer to avoid clip is chosen.

6.3.2 Motion Flow Mode

In Motion Flow mode, you combine .bip files, using either velocity-interpolated transitions or optimized transitions that compute minimum foot sliding, to create longer character animations. First, clips are added and referenced to .bip files in the Motion Flow Graph. These are then selected to create a Script in the Motion Flow Script list. The Transition Editor is used to adjust transitions between .bip files. Scripts, transitions and clip references are saved in a Motion Flow Editor file (.mfe) for later editing.

6.3.3 Random Motion and Crowds

Random motions can be created for one or more bipeds using the Create Random Motion command. For example, you can animate a crowd of bipeds. For a crowd, you must share one motion flow script among many bipeds.

If you are driving a crowd using delegates and behaviours, then rather than a completely random motion, the software picks appropriate clips based on the delegate's speed and direction. If the delegate slows to a stop, the software will find and use a clip that slows to a stop, if one exists.

In all crowd simulations, you must load clips and create transitions before synthesizing the crowd motion. Often, many clips are used to synthesize crowds. Automatic transitions relieve you of having to create transitions between clips manually.

6.3.4 Motion Flow Graph

Motion Flow

Display the Motion Flow Graph; load and save motion flow files (.mfe). The Motion Flow rollout also contains a Scripts section where you can create scripts, edit transitions, create a unified motion and create random motions for the bipeds.

Use tools in the Motion Flow Graph to add clips to the graph, calculate optimized transitions, set random script transition values, move and delete clips and display clip dependencies. Clips and transitions display as icons in the Motion Flow Graph dialog. The Motion Flow Graph is displayed, when you click on Show Graph on the Motion Flow rollout on the Motion panel.

The first step in Motion Flow mode is to add clips in the Motion Flow Graph for use in scripts. Clips represent all or part of a .bip file. Scripts represent different paths through the clips in the Motion Flow Graph. The first clip in the current script is red. Transitions are shown as arrows between clips; red arrows represent the path through the active script. Black transition arrows indicate unloaded scripts. A transition looping back to the same clip represents a cycle or loop.

Create Clip: Select and click in the dialog window to create clips.

Create Multiple Clips: Load multiple motion files.

Create Transition From –> To: Create a transition between two clips.

Create Transition To –> From: Create a transition between two clips.

Create All Transitions: Creates transitions between every clip, including loop transitions.

Delete Clip/Transition: Deletes a clip or transition.

Select Clip/Transition: Selects a motion clip or transition.

Move Clip: Moves clips within the Motion Flow Graph.

This does not affect the animation.

Pan: Pans the layout of the clips.

Zoom: Adjusts the view magnification of the Motion Flow window. Drag up to increase magnification.

Zoom Region: Click Zoom Region mode to drag a rectangular region and magnify that region to fill the Motion Flow Graph window.

Fit to Window: Re-sizes the contents to fit the size of the Motion Flow Graph window

Save Clip Files: Letyou set a path where selected clip files can be stored

Clip Mode: Edit biped footsteps and limbs for the selected clip.

Show Script Dependencies: Displays the scripts that use the selected clip.

Select Random Start Clips: Turn on and select clips in the Motion Flow Graph window.

Show Random Percentages: Displays clip and transition percentages in the Motion Flow Graph window.

Optimize Selected Transitions: Select one or more transitions and then click Optimize Selected Transition to optimize them.

Show Optimal Transition Costs: Displays costs in the Motion Flow Graph window.

Check All Transitions: Checks the graph for overlapping transitions and transitions whose length is too long for the clip.

Auto Clip Names: Names the clip based on the name of the motion file.

Study Notes

Assessment

1. Can you save, load and append MFE files from the Motion flow rollout?
2. Briefly discuss the function of Auto Clip Names.

Discussion

Link walk and run animation and use motion flow graph with the above option of a graph.

6.4 Transition Optimization

Options in the Transition Optimization dialog box allow you to select the range over which the optimize algorithm will search for the transition. Either it can search the whole clip or it can search near the existing transition. You must specify the preferred length of the optimized transition.

Preferred Transition Length: Specify the length of the optimized transition.

Search Entire Clip: Search the entire clip for an optimized transition start frame.

Search near Existing Transition: Create an optimized transition near the existing transition.

	Study Notes

	Assessment

1. __________ for an optimized transition start frame.
2. Motion Flow Mode > Motion Flow Graph > Select transitions in the graph window. > Optimize Transitions > Transition dialog. Is that the correct path?

	Discussion

Practically use the transition optimization in jump and walk animation.

6.5 Clip Properties Dialog

Parameters in the Clip Properties dialog allow you to browse for a clip, set a start and end frame for the clip and set a random start probability for the clip. Random start probability is used when you use Create Random Motion to generate a random script for a biped.

Study Notes

Assessment

1. Select a biped > Motion panel > General rollout > Motion Flow Mode > Motion Flow rollout > Motion Flow Graph > Motion Flow Graph dialog.
2. Is that the correct path to use clip properties dialog?
3. The___________ as it appears in the Motion Flow Graph.

Discussion

Create multiple clip and loop it with motion flow graph and use clip properties in it.

6.6 Transition Editor

Display the Transition Editor by selecting a clip in the list of the Scripts group and clicking Edit Transition in the same group or right clicking a transition arrow in the Motion Flow Graph.

6.6.1 Transitions

A good transition links two clips together seamlessly; the motion through the transition should appear natural, as though the motion was captured as one long motion sequence. Like an AB roll transition in video editing, an appropriate section in both clips is selected for the transition (dissolve) from the source clip to the destination clip. Velocity differences between the source and destination clips are matched during the period of transition producing a seamless result.

By default, Minimum Motion Loss is used to find likely start frames in the source and destination clips when clips are appended to a script. Optimized transitions can be computed by using Optimize Transition in the upper right-hand corner of the Transition Editor dialog. Optimized transitions use a minimum foot sliding method to compute transitions. Optimized transitions take longer to compute, but produces very smooth motions.

6.6.2 Automatic Transitions

When you create a script, default transitions are used between the clips. Default transitions are used for minimum motion loss and are quick to compute.

6.6.3 Length / Transition Duration

Set the duration of a transition in the Length field. A value of 10, for example, creates a transition of 10 frames between the source and destination clips.

6.6.4 Editing Transitions Manually / Ghosts

Manually setting the Start Frame for the source and destination clips offers the most control. Unwanted motion in either clip can be avoided and judging the best Start Frames for both clips is left to you.

Probability: Set a probability value for random transitions. This is used by Create Random Motion when a random script is generated.

Length: Sets the number of frames for the duration of the transition.

Ease In: Ease in value for the source clip.

Ease Out: Ease out value for the destination clip.

Transition Focus: Letyou specify a focus point on the biped where the transition takes place.

Center Of Mass: The transition focus is based on the center of mass position of the biped as it transitions from one clip to the next.

Left Foot: The transition focus is based on the left foot position of the biped as it transitions from one clip to the next.

Right Foot: The transition focus is based on the right foot position of the biped as it transitions from one clip to the next.

Both Feet: The transition focus is based on an averaged foot position of both of the biped's feet as it transitions from one clip to the next.

Angle: Sets the direction of the destination clip.

Previous Transition: Go to the previous transition in the script.

Next Transition: Go to the next transition in the script.

Optimize Transition: Displays the Transition Optimization dialog.

Go To Start Frame: Moves the time slider to the first frame of the transition.

Start Frame: Set the transition start frame for the source and destination clips in their respective fields.

Rolling: Keep the clip in motion during the transition.

Fixed: Freeze the biped at the Start Frame position during the transition.

6.6.5 Ghost group

The Ghost area Frame spinners allow you to view and scrub the source and destination clips by displaying stick figures (ghosts); yellow and red stick figures represent the source and destination clips. The source and destination bipeds may not be close to each other during this scrubbing process; the destination clip will be repositioned when Set Start Frame is clicked. When a suitable start frame is located, click Set Start Frame to copy the values in the Frame field to the Start Frame field. Monitor foot position status in the field provided.

Set Start Frame: Copy the value in the Frame field of the Ghost area to the Start Frame field in the Clip area to match both bipeds.

Frame: Use the Frame spinner to scrub a stick figure back and forth, which allows you to determine a start frame for the source and destination clips.

- Playback: You can play back the transition from within the Transition Editor dialog.
- Play Transition Icon: Toggles the playback of transition.
- Speed: Changes the playback speed.
- Frames Before/Frames After: Sets the number of frames to play before and after the transition period.
- Selected Only: When checked, plays only the selected biped in the scene.
- Play Ghosts: When checked, shows transition ghosts during playback.
- Create Transition: Click to create a new transition. The transition number field increments, edit and name the new transition. Any number of transitions can be stored.
- Delete Transition: Click to delete a transition.
- Previous Transition: Go to the previous stored transition. This button is grayed if no previous transition exists.
- Next Transition: Go to the next stored transition. This button is grayed if no next transition exists.
- Ok: Store transitions and exit the dialog.

	Study Notes

	Assessment

1. The ____________Frame spinners allow you to view and scrub the source and destination clips by displaying stick figures (ghosts); yellow and red stick figures represent the source and destination clips.
2. What is the function of the Play Transition Icon

	Discussion

Discuss Ghost group's option after applying in biped animation process.

6.7 Summary

COMBINING BIP MOTIONS

Character studio offers two ways of combining BIP files to build character animations:

- The motion-flow script joins clips together using transitions.
- Mixer scripts can combine and adjust the upper-body movement of one biped with the lower-body movement of another and also provide a number of other effects.

MOTION CAPTURE CONVERSION PARAMETERS

Filtering motion-capture data lessens keys, making the job of altering or personalising the motion data much simpler.

FOOTSTEP EXTRACTION

Some Options are active when Footstep Extraction is on.

LOAD FRAMES

Carried out with the help of a dialog box.

Key Reduction

Key reduction keeps the original motion intact and intelligently filters out more than 80 percent of the keys in the motion-capture file, making the process of altering the biped animation much simpler.

Limb Orientation

The biped elbow and knee hinge joints are perpendicular to the triangles formed by the shoulder-elbow-wrist and hip-knee-ankle respectively. Errors can be resolved in the motion-capture data that break this rule by using either the angle or point method.

Talent Definition

Save Talent Figure Structure and Save Talent Pose Adjustment files can be loaded in the Talent Definition area when importing marker files created by the same actor in a motion capture session.

Motion-Capture Buffer

The motion-capture buffer is used to try new filtering options with the Convert from Buffer command and to paste keys from the raw motion-capture data to the biped using Paste From Buffer on the Motion Capture rollout.

Sliding Footsteps

Filtering motion-capture data reduces keys, making the job of altering or personalising the motion data much simpler. You can also run standard .bip files through this filtering process to create loops or to extract footsteps from a freeform animation.

Motion Capture Import

While importing motion capture data you can import rotation and position type data.

Footstep Extraction

Some options are active when Footstep Extraction is on during motion capture conversion.

Filtering Motion-Capture and Marker Data

Filtering motion-capture data reduces keys, simplifying the job of altering or personalising the motion data.

Understanding Motion Flow

In Motion Flow mode, you combine BIP files to create longer character animation. You also use motion flow along with crowd animation to automatically generate crowd behaviour.

Working with Motion Flow

Motion flow mode is used to organise clips into a network to animate one or more bipeds. The network of clips is joined together by transitions.

Motion Flow Mode

In Motion Flow mode, you combine .bip files, using either velocity-interpolated transitions or optimized transitions that compute minimum foot sliding, to create longer character animations.

Random Motion And Crowds

Random motions can be created for one or more bipeds using the Create Random Motion command.

One Additional Rollout Display in Motion Flow Mode:

The Motion Flow rollout also contains a Scripts section where you can create scripts, edit transitions, create a unified motion and create random motions for the bipeds.

Motion Flow Graph

Tools in the Motion Flow Graph are used to add clips to the graph, calculate optimized transitions, set random script transition values, move and delete clips and display clip dependencies.

Transition Optimization

Options in the Transition Optimization dialog box allow us to select the range over which the optimize algorithm will search for the transition.

Clip Properties Dialog

Parameters in the Clip Properties dialog allow us to browse for a clip, set a start and end frame for the clip and set a random start probability for the clip.

Transition Editor

The Transition Editor can be displayed by selecting a clip in the list of the Scripts group and clicking Edit Transition in the same group or right-clicking a transition arrow in the Motion Flow Graph.

Transition

A good transition links two clips together seamlessly; the motion through the transition should appear natural, as though the motion was captured as one long motion sequence.

Automatic Transitions

When you create a script, default transitions are used between the clips. Default transitions used for minimum motion loss and are quick to compute.

Ghost Group

The Ghost area Frame spinners allow us to view and scrub the source and destination clips by displaying stick figures (ghosts); yellow and red stick figures represent the source and destination clips.

6.8 Self-Assessment Test

Broad Question

1. What is Motion Flow?
2. How Motion-Capture Data is acquired?
3. What is key reduction?
4. Discuss about Random Motions and Crowd.

    a. Motion capture
    b. Types of motion capturing
    c. Footstep extraction
    d. Key reduction
    e. Motion flow graph
    f. Transition editor

6.9 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. The Animator's Motion Capture Guide: Organising, Managing, Editing, Matt Liverman
5. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
6. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei
7. Understanding Motion Capture, Alberto Menache

Assignment

Use Motion Flow to create more realistic freeform animation.

CHARACTER ANIMATION

BCADES-208

BLOCK 3:

NON-LINEAR ANIMATION

Dr. Babasaheb Ambedkar Open University, Ahmedabad

Education is something which ought to be brought within the reach of every one.

- Dr. B. R. Ambedkar

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Open University

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CHARACTER ANIMATION

Block

3

NON-LINEAR ANIMATION

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

Unit 1 Motion Mixers

Learning Outcome

After going through this unit, you will be able to:

- Display how the motion mixer works
- Show how to animate the COM of the Biped to adjust the balance
- Work on the mixer track
- Apply transitions on the multiple tracks in motion mixer
- Experiment on how to group motions in mixer
- Work with the different tracks

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

7.1 Introduction to Motion Mixer

7.2 Adjusting Biped Balance in the Mixer

7.3 Filtering Mixer Tracks

7.4 Adjusting Track Weight

7.1 Introduction to M otion Mixer

The Motion Mixer allows you to mix motions for a biped's animation.

The Motion Mixer takes its design from the world of audio. When a so ng is recorded in a studio, each instrument is played and recorded separately. Each recording is called a track. The tracks are then put together in a sound mixer so they play simu ltaneously or overlap one another. During th e mixing process, the mixer operator can change the length or speed of a track, increase or reduce volume, move a track to another place in the song or cause a track to fade in or out.

The Motion Mixer works in a similar way. For any biped, you can add m ultiple tracks to the mixer, each holding a se parate series of motion clips (BIP files). You ca n trim clips to use only part of a motion, make the clips play slower or faster or create transitions from one clip or set of clips to another.

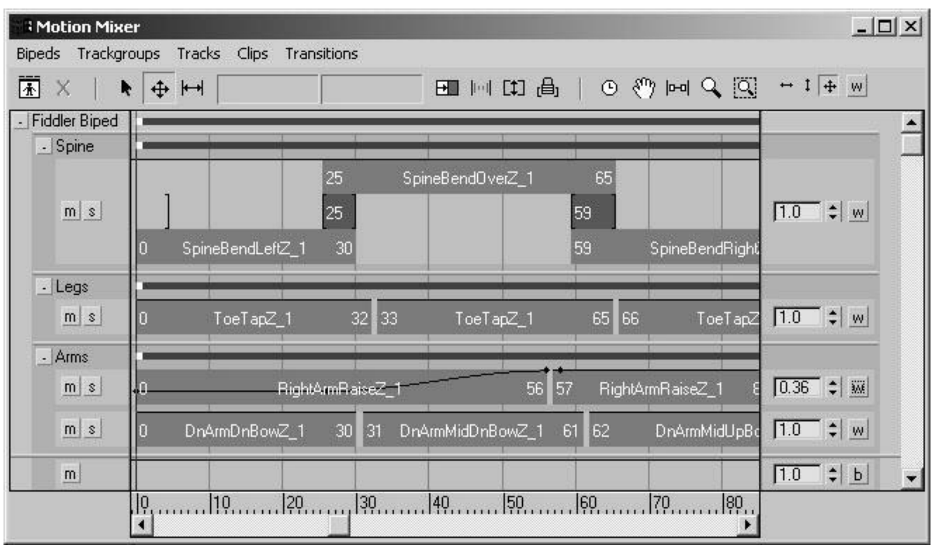

Fig. 7.1: Motion Mixer Window

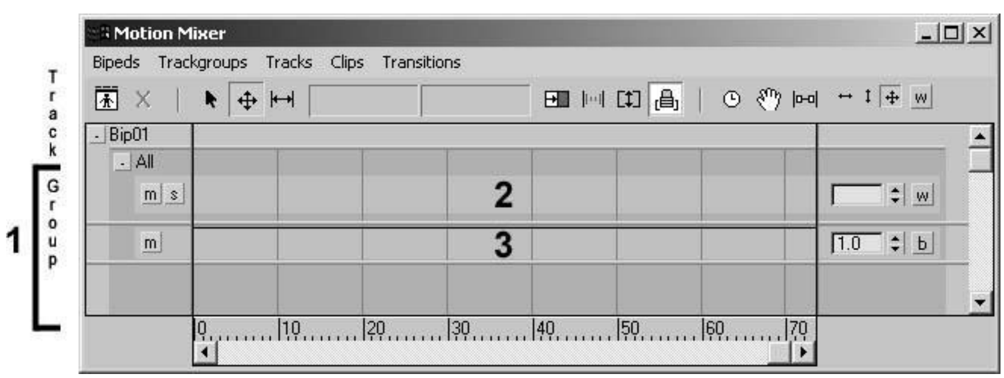

Fig. 7.2: Track Groups in Motion Mixer

Layer: A track for a series of motions that do not need transitions between them. By default, a layer track is created f or a biped when you open the mixer.

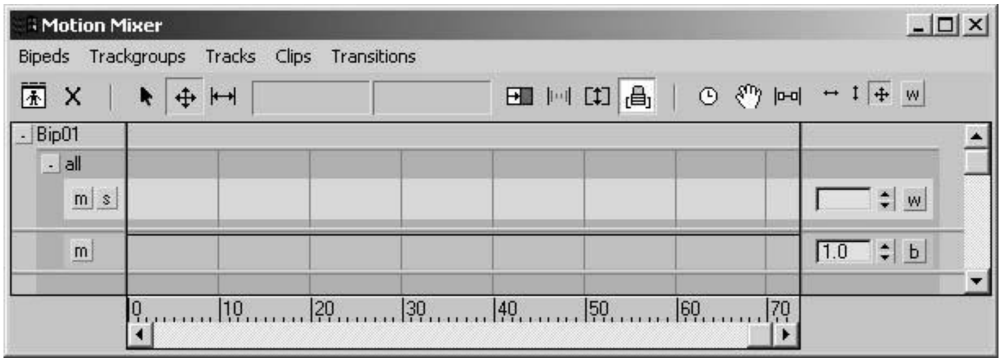

Fig. 7.3: Motion Mixer with Bip01 layer

Transition: A tall track with room for two rows of clips.

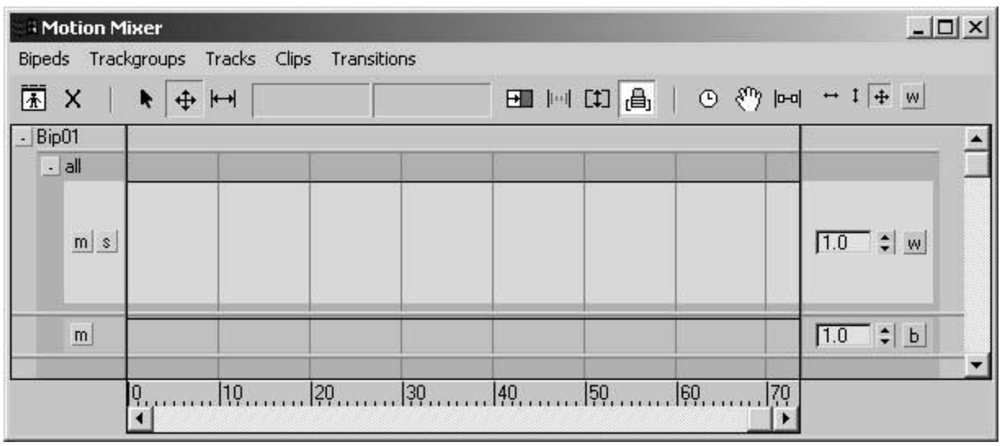

Fig. 7.4: Tr ack labelled ms is a Transactions Track

7.2 Adjusting Biped Ba lance in the Mixer

When you use different motions on the upper and lower parts of the biped, you can create a situation where the bal nce in the two clips does not match one another.

For example, if the arms are waving wildly in the motion used for the upper body, the hip motion should compensate to some degree to keep the biped in balance. A straight mix of this arm motion with another hip/leg motion will most likely not match up in terms of balance.

By default, the Mixer co mpensates for differences in upper and lower body motion by making slight alterations to the spine and pelvis motions. If the biped bend s over at the waist, for example, the pelvis will be moved to compensate for the weight shift and the spine rotation will be lessened to help the biped keep its balance.

Balance compensation is intended to make the biped's motion look as natural as possible.

Study Notes

Assessment

State true or false

1. Adjusting Biped balance means balancing Biped or balancing clips.
2. The Motion Mixer takes its design from the world of audio.

Discussion

Add clips in Motion mixer and adjust the balance.

7.3 Filtering Mixer Tracks

Each track in the Motion Mixer is part of a track group. Each track group can be filtered so it uses motions from one set of body parts and not another. For example, you might want to use the arm motions from one motion file with the legs from another. For this purpose, you would need two separate trackgroups.

There are two steps involved in filtering with track groups:

- Create additional track groups as needed in the Mixer.
- Filter each track group (set it to use some body parts but not all) and name the track group appropriately. This is accomplished with the Track group Filter dialog.

	Study Notes

	Assessment

State true or false

- Motion mixer track is the part of track group.
- List the number of steps involved in filtering with track groups

	Discussion

In Motion mixer, use filtering mixer tracks.

7.4 Adjusting Track Weight

Each track has one or more weight curves that you can use to mix motion from several tracks to varying degrees. The weight curve determines how much a specific track contributes to the motion within the trackgroup.

With weight curves, you can create several full or partial transitions between all the tracks in a trackgroup. Compare with transitions on a transition track, which can only create a full transition between two clips.

Weight curves are useful for:

- Creating transitions between two tracks in a trackgroup
- Creating random motion
- Experimenting with transitions quickly and easily

Each track's weight curve appears as a thin black line across the top of the track.

Study Notes

Assessment

1. Creating transitions between two tracks in a track group is useful to Weight curves. (True / False)
2. Using ___________ you can create several full or partial transitions between all the tracks in a track group.

Discussion

In motion mixer, adjust track weight.

7.5 Transition Track

Transition track is a Motion Mixer track, which allows you to stack clips on top of one another and to create automatic transitions between them. Transitions on these tracks are similar to those in a Motion Flow network. Compare it with a Layer track, which allows cuts only between clips.

Study Notes

Assessment

Fill in the blanks

1. Transition track:A ____________that allows you to stack clips on top of one another and to create automatic transitions between them.
2. Transitions on these tracks are similar to those in a _____________network.

Discussion

Work with the transition track by using biped animation files in motion mixer and learn its function(s).

7.6 Layer Track

Layer track is a Motion Mixer track for a series of motions that do not require transitions between them. Compare this with a Transition track, which allows you to stack clips on top of one another and to create automatic transitions between them. When a biped is added to the Motion Mixer, it is automatically assigned a Layer track.

Study Notes

Assessment

1. How many types of tracks are there to which you can add clips and name it?
2. When a biped is added to the Motion Mixer, it is automatically assigned a Layer track. (True / False)

Discussion
Add the biped animation clips by using the Layer track.

7.7 Mixer Preferences Dialog

The Motion Mixer Preferences dialog let you make changes to display settings for clips, transitions and frames. It is similar to the way you can hide by Category on the Display panel.

You can also specify mix down options from this dialog.

Study Notes

Assessment
1. Select a biped>Motion panel>Biped Apps rollout>Mixer>Preferences and 2. Graph Editors menu>Motion Mixer>Preferences. Is this the correct path? 3. In Motion Mixer Preferences dialog, you can hide by Category on the Display panel. (True / False)

	Discussion
Explain practically motion mixer preferences dialog.	

7.8 Show / Hide Group

These settings affect how clips appear in the Motion Mixer tracks.

Names:When turned off, clip names do not appear on the coloured clip bars in the Motion Mixer.

Scales: Displays the clip scale. Since clips can be resized by using tools like move clips, displaying the scales quickly lets you know if a clip is two times its original length or half its length.

Boundaries: Turns on and off the frame numbers at the start and end of the coloured clip bars.

Weight Curves: Toggles the display of the weighting line. It does not matter if the weight button is active or not.

Time Warps: If a time warp has been added to a clip, this switch toggles the display of the warp on the coloured clip bar.

Show / Hide Transitions Group

The two settings affect how transitions appear in the Motion Mixer tracks.

Inpoints: Toggles the beginning transition frame on the transition clip bar.

Outpoints: Displays the end transition frame on the transition clip bar.

Show / Hide Other Group

These settings indicate if range bars and balance curves appear in the Motion Mixer tracks.

TrackgroupRangebars: Hides the gray range bar that appears along the top of each trackgroup.

Balance Curves: Displays the balance curves track.

	Study Notes

	Assessment
1. What is the function of Show/Hide group? 2. Explain the purpose to use TrackgroupRangebars.	

	Discussion
Use Show/Hide group while working in Motion Mixer.	

7.9 Frame Display Group

These settings affect how clip boundaries and transition in/outpoints appear in the Motion Mixer.

Global: Displays clip start and end frames as frame numbers. inpoints and outpoints of transitions display the frame at which transitions start and end.

Local: Clip boundary values are displayed as actual lengths in frames.

Mixdown Options Group

These settings affect how transitions appear in the Motion Mixer tracks.

Prompt For Options At Each Mixdown: When turned on, the mixdown options dialog is displayed.

A Keyframe Per Frame: When turned on, a keyframe is generated for each frame of animation when the mixdown is computed.

Enforce IK Constraints: When a transition occurs between two clips where the same foot or feet are planted with footsteps or planted keys, this option forces the foot/feet to stay planted during the transition.

Continuity Range: Sets an additional transition time after the actual transition, giving the foot time to get from its planted position to its keyframed location in the next clip.

Filter Hyper–Extended Legs: Prevents a leg from straightening during a transition.

Max Knee Angle: Sets the maximum angle that can be reached between the thigh and calf before the heel comes off the ground.

Importing Clips tothe Mixer

You can bring motion clips (BIP files) into the mixer with any of these methods:

- Choose a file directly from the folder in which it resides.
- Choose a file from those you have placed in the Reservoir, a storage area for BIP files.
- Import motion from another biped in the scene.
- Import a motion flow script

Study Notes

	Assessment

1. What do Frame Display Group settings affect?
2. Describe Global and Local option from Frame Display Group.

	Discussion

Create and write sequence of importing clips in motion mixer.

7.10 Interpreting Clip Names

When you load a clip into the Mixer, the clip appears on the track as a solid bar, with its name displayed on the clip.

When you load a clip into the Mixer for the first time, the number 1 follows the clip name. If you clone or load the same clip to another part of the Mixer, the clip will display the same number or a different number depending on whether the new clip is an instance or an adaptation of the original clip. Instances are versions of the same clip used with the same biped or different bipeds of the same size. Adaptations are versions of the clip used with bipeds of different sizes.

	Study Notes

Assessment

1. When you load a clip into the Mixer for the first time, the number 1 follows the clip name. (True / False)
2. Adaptations are versions of the clip used with ------------- of different sizes.

Discussion

Observe a clip from motion mixer.

7.11 Instance

In 3ds max, an instance is a interchangeable clone of the original object. Modifying an instanced object is the same as modifying the original.

The term instance has two meanings in character studio. One is the definition used with 3ds max. The other is specific to clips in the Motion Mixer.

Instances are not only alike in geometry, but also share modifiers and materials. When you change one instance by applying a modifier, for example, all the other instances change with it.

Each instance has its own set of transforms, object properties and space warp bindings. These are not shared among instances.

Within instances, derive from the same master object. What you're doing is applying a single modifier to a single master object. In the view port, what you see as multiple objects are multiple instances of the same definition.

7.11.1 ADAPTATION

In the Motion Mixer, when the same clip is used more than once on tracks, the clip versions are either instances or adaptations of one another.

The same clip used more than once for one biped or for different bipeds of the same size, is an instance. The same clip used for different-sized bipeds is an adaptation.

These terms are used because the Mixer adapts each loaded clip to the biped's size. The first time a clip is loaded, the Mixer adapts the clip as needed. When the clip is cloned or loaded again, the Mixer adapts the new clip to the biped as needed and then compares the change to previously loaded versions to see if it is the same. If so, the new clip and its previous versions are instances of one another. If not, the new clip and previous versions are adaptations of one another.

In footstep animation, the term adaptation refers to keys generated for a footstep sequence. When you edit active footsteps, body and leg keys are adapted automatically. By analogy, the footsteps become a kind of "gizmo" for manipulating the key frames of your character's animation. In most cases, the changes you make to footsteps, , act upon your keys in an intuitive fashion.

Then suppose you add a third biped of a different size and use the same clip in that biped's mix. The new version of the clip is an adaptation of the clip used on the first two bipeds. An incremental number is added to the end of the clip name in the Mixer.

These terms are used because the Mixer adapts each loaded clip to the biped's size. The first time a clip is loaded, the Mixer adapts the clip as needed, but no distinction is made between instances and adaptations at that point because the clip appears only once.

When the clip is cloned or loaded again, the Mixer adapts the new clip to the biped as needed and then compares the change to previously loaded versions. If the change is the same, the new clip and its previous versions are instances of one another. If not, the new clip and previous versions are adaptations of one another.

7.11.2 Using theReservoir

The Reservoir Serves As A Storage Facility For Motion Clips (BIP Files) That You Use With The Motion Mixer. You Can Load Clips Directly Into The Reservoir and All Clips That You Load Directly In The Motion Mixer Also Show Up In The Reservoir.

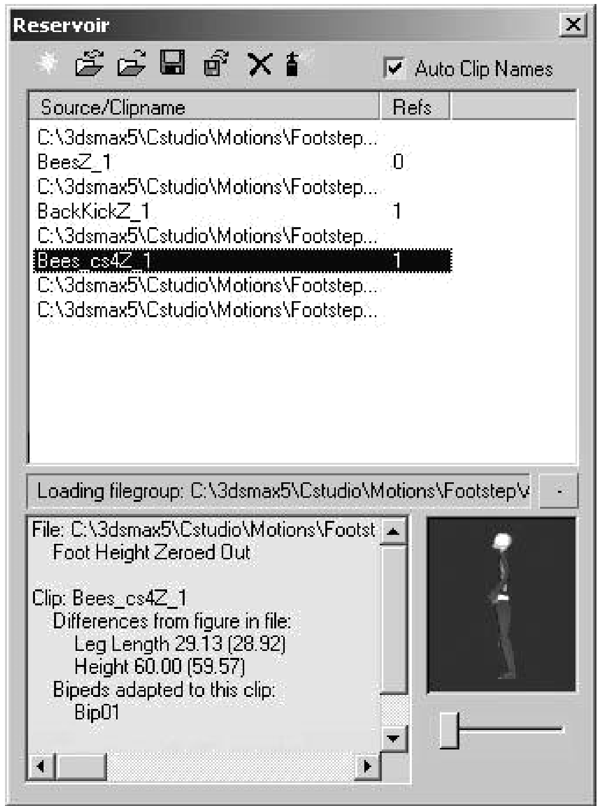

Fig. 7.5: Reservoir Dialogue

For each motion file use d in the Motion Mixer, the Reservoir list sho ws the source (disk path and name of the file) and, under the source, shows the name of eac h clip or set of clips derived from that file.

The Motion Mixer can apply multiple adaptations (occurrences of the clip for different-sized bipeds) to differ ent bipeds. In the Reservoir, the various clip ad aptations are listed under the clip name.

7.11.3 Saving Clip Adaptations

The Reservoir let you sa ve a unique version of an adapted clip to a new BIP file. This new file will contain the new biped's size data, so it will not have to be adap ted when it is loaded into the Mixer.

If you are mixing long BI P files on a biped of a size other than the size u sed to create the BIP file, when you reload th e MAX file or load a MIX file, you might have to wait while the Mixer recalculates the ada ptation for the biped. You can save loading time by saving adapted clips to new BIP files and replacing the original clip in the Mixer.

If you save an instanced clip from the Reservoir under a new file name, all clips in the Reservoir are renamed likewise.

	Study Notes

	Assessment
1. Modifying an instanced object is the same as modifying the -----------------. 2. When will the Mixer recalculate the adaptation for the biped?	

	Discussion
Study the Reservoir from Motion mixer by using it in animation file.	

7.12 Creating a Motion Flow Script

A script is a list of clips (.bip files) that controls the character you are animating. To create a script, add clips to the Motion Flow Graph, then click Define Script in the Scripts section of the Motion Flow rollout and click a sequence of clips in the Motion Flow Graph. Default transitions are assigned if no transitions exist between the clips. The clip names and starting frame numbers display in the list on the Motion Flow Script list.

7.12.1 Motion Flow Rollout

The Motion Flow rollout displays when Motion Flow mode is turned on in the Biped rollout. Load, append and save motion flow editor files (.mfe), display the Motion Flow Graph and display the Shared Motion Flow dialog using controls on this rollout.

Load File: Load a motion flow editor file (.mfe). the motion flow editor files include:

- Clips: References to biped animation files
- Transitions: Names, attributes and connections between clips
- Scripts: Different paths through a set of connected clip and transitions

Append File: Appends a motion flow editor (.mfe) file to the .mfe that is already loaded.

Save File: Save a motion flow editor (.mfe) file.

Show Graph: Opens the motion flow graph. The first step in script creation is to add clips to the motion flow graph.

Shared Motion Flow: Displays the shared motion flows dialog. Allows you to create, delete and modify shared motion flows.

If the selected biped is using a shared motion flow, then the icon has a white circle around it.

7.12.2 Shared Motion Flow Dialog

Controls in the Shared Motion Flow dialog allow you to assign one motion flow to multiple bipeds. Instead of choreographing a motion flow script for individual bipeds, you can create a motion flow with all the clips and transitions to create a script to animate multiple bipeds. Random motion creation will use each bipeds own motion flow. If a biped's motion flow happens to be a shared motion flow, then the shared motion flow will be used to compute random motion.

A biped that shares a motion flow shares only the graph. Its scripts are unique to that biped, although the scripts point to the clips of the shared motion flow. You can manipulate that biped's motion flow and scripts. You can create random motion on a biped that shares a motion flow or create a motion flow script via the crowd system.

Shared Motion Flows List: Lists shared motion flows.

New: Creates a new-shared motion flow.

Delete: Deletes the current shared motion flow.

Load: Loads a shared motion flow (.smf) file.

Save: Saves a shared motion flow (.smf) file.

Load .Mfe: Displays a load file dialog. load an .mfe file into the shared motion flow.

Bipeds Sharing This Motion Flow List: Lists the bipeds that share this motion flow.

Add: Displays a dialog where you can choose bipeds to add to the motion flow list.

Remove: Removes the selected bipeds in the list from the current shared motion flow.

Put Multiple Bipeds In Motion Flow: Put the bipeds in the list into motion flow mode.

Take Multiple Bipeds Out Of Motion Flow: Take the bipeds in the list out of motion flow mode.

Set Shared Moflow Leg Scale: Adapts the shared motion flow to the scale of the biped currently selected in the list.

Reset Wrong Scales: Just Legs: Reset the leg scale only of the bipeds that have the wrong scale, so that they adapt appropriately to the shared motion flow.

Reset Wrong Scales: Entire Figure: Resets the entire figure structure of the bipeds that have the wrong scale, to match the figure structure of the correctly scaled biped.

7.12.3 Motion Flow Graph Dialog

Use tools in the Motion Flow Graph to add clips to the graph, calculate optimized transitions, set random script transition values, move and delete clips and display clip dependencies. Clips and transitions display as icons in the Motion Flow Graph dialog. The Motion Flow Graph displays when you click Show Graph on the Motion Flow rollout on the Motion panel.

The first step in Motion Flow mode is to add clips in the Motion Flow Graph for use in scripts. Clips represent all or part of a .bip file. Scripts represent different paths through the clips in the Motion Flow Graph. The first clip in the current script is red. Transitions are shown as arrows between clips; red arrows represent the path through the active script. Black transition arrows indicate unloaded scripts. A transition looping back to the same clip represents a cycle or loop.

If the biped is using a shared motion flow, then the title of the graph window will say

"*SHARED* Motion Flow Graph", followed by the name of the shared motion flow. Shared Motion Flows are used to control multiple bipeds with one shared motion flow.

By default, minimum motion loss is used to compute transitions. Optimized transitions use an algorithm that uses minimum foot sliding. Optimized transitions take longer to compute but yield very high quality results.

7.12.4 Adjusting Clip Timing

In the Motion Mixer, you can shorten clips or change their timing interactively within the track display. You can change the timing of motion clips in a number of ways:

- Change the length of a clip without changing its speed by trimming the clip at the start or end.
- Change the speed of an entire clip by stretching it out or shrinking it.
- Cause varying changes in speed throughout the clip with time warps.

7.12.5 Adding Time Warps

You can cause varying changes in speed throughout a clip with a time warp. Adding a time warp to a clip allows you visually to squash and stretch time over different parts of the clip. You can use a time warp to:

- Cause the biped to do some parts of the motion quickly and others slowly.
- Cause a particular motion within the clip to occur at a specific time.

You use a time warp by picking a time within the motion clip and dragging that time's motion to another time in the same clip. The overall time of the clip is unchanged, so the biped takes the same amount of time to do the entire motion, but does some parts quickly and others slowly.

7.12.6Working withClips In The Mixer

Once you have created tracks and imported clips to the Motion Mixer, you can adjust your animation mix by moving, cloning and replacing clips. Within the Motion Mixer, you can:

- Move clips in time within the same track.
- Move clips to other tracks.
- Clone clips.

- Slide all clips in time on a track.
- Replace a clip with motion from a biped, a motion flow script or another clip.

7.12.7 Motion Mixer Editor

The Motion Mixer window contains an editor where you manage everything that is added to the mix: bipeds, track groups, tracks, clips and transitions.

7.12.8 Biped/Track Group/Track Controls

The left-most section of the editor is the Biped/Track group/Track Controls section. The Biped/Track group/Track Controls set the number, order, display and characteristics of those features in the mix. Bipeds and track groups can be selected, added, removed and repositioned.

7.12.9 Interactive Clip Controls

The center section of the editor, Interactive Clip Controls, let you manipulate the scale, time, timing and trimming of clips and transitions.

The overall length of all clips and transitions in a track can be stretched or squeezed by dragging the white ends of the gray range bars along the top of each track group. Drag from the middle of the range bar if the entire mix of a track group needs to be moved. Likewise, clips can be moved by dragging from the middle of a clip. Clips and transitions can be shortened or lengthened by dragging either end.

The range bar for each biped can also be moved or scaled to move or scale the entire mix for the biped.

Transition brackets appear in Transition tracks. Where a transition exists, the brackets indicate the start and end points of the transition. If there is no transition at the end of the clip, the bracket indicates where the transition will be placed when a new clip is loaded into the track.

7.12.10Weighting Controls

The weighting controls at the rightmost end of the editor let you set the weight with which a clip or track will be blended with other tracks within the same track group.

When Weight Mode is turned on, weights can be adjusted with a red weight curve on a clip or track.

On a Layer track, each clip has its own weight curve. Each Transition track has one weight curve for the entire track. By default, each weight curve has a node at each end that can be moved to change the weight at that point. Click on the weight curve to add more nodes and drag a node to move it.

Weights can range from 0.0 (no weight) to 1.0 (full weight). The weight for the currently selected node appears to the left of the Weight Mode button. You can change the weight by moving the node or by changing the spinner value.

When you have multiple weight nodes selected and you use the spinner to set a new value, weight node values are changed, relative to their original values. In this case, you cannot spin the spinner lower than 0 or higher than 1 on any one spin. If you have more than one weight node selected and you type in a weight, the weights of all nodes are changed to the new value.

Weighting is evaluated across tracks in a single-track group. If a track group has two or more tracks, the topmost track's weight is evaluated at each frame. If the weight at any frame is less than 1.0, the motion on the track is only partially used and next track down is evaluated for its weight. If the total weight is still less than 1.0, the next track down is evaluated and so on. In this way, motion from multiple tracks can be mixed at the same frame for the same set of body parts.

The Weight Mode button at the right end of the main toolbar turns on this mode for all tracks in the Motion Mixer

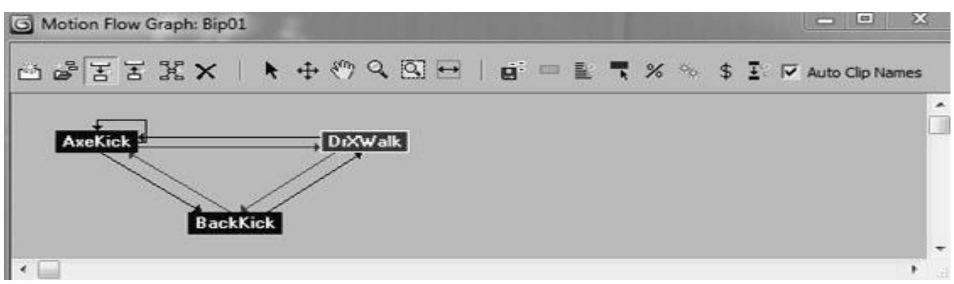

Fig 7.6 Motion Flow Graph

	Study Notes

	Assessment

1. Which file do you have to load while creating Motion flow Script?
2. Which side do you get when weighting controls in motion flow editor?

	Discussion

Using two .BIP clips try out the motion flow script.

7.13 Motion Mixer Menus

The Motion Mixer interface contains five menus located at the top of Motion Mixer window.

7.13.1Bipeds Menu

The Biped menu provides tools for managing your bipeds when a biped is selected. If a biped is already added to the Motion Mixer, right clicking a biped's name displays the menu. Use commands on this menu to load and save MIX files, adjust track colours and balance parameters and activate and deactivate the Mixer mode.

Add Track Group: Adds A Track Group To The Top Of The Selected Biped's Mixes.

Track Colour: Allows You To Change The Colour Of The Clips In The Selected Biped's

Mixes.

Balance Parameters: Clicking Balance Parameters Opens The Balance Parameters Dialog.

- Lateral Ratio: Decreasing the Lateral Ratio to 0.0 will cause balance compensation to use only forward/backward motion on the pelvis.

Propagation: Affects the degree to which spine links are rotated to follow com and pelvis rotation. When set to 0.0 (the default), spine rotation is not influenced by lower body motion. When set to 1.0, all spine links except the topmost one use the lower body motion's spine animation to some degree to better follow the com and pelvis motion.

Delete: Clears the selected biped(s) from the mixer.

Load Mix File: Opens a dialog where you can select a mix file to load into the mixer.

Save Mix File: Opens a dialog where you can save the current biped's mix to a mix file.

Copy Mix Down To Biped: Copies animation from the mix down track to the biped.The animation remains on the biped even after mixer mode is turned off and the animation can be saved as a bip file.

Compute Mix Down: Performs a mix down on the selected biped(s). A mix down track appears at the bottom of each biped's mix.

An inactive Mix down track (above) and an active Mix down track (below)

A mix down can make automatic adjustments to transitions between planted foot motions.

Delete Mix Down: Removes the mix down from the mix of the selected biped(s).

Effect Raw Mix: When this option is turned on, mixer mode is turned on for the biped.

Effect Mix Down: When this option is turned on, the mix down track is activated. This option is available only if a mix down has been computed.

Effect Biped: When this option is turned on, mixer mode is turned off for the biped. Click effect raw mix to turn mixer mode on again.

7.13.2 Track Groups Menu

When a track group is selected, you can access the commands in the Track group menu. Alternately, you can right-click a track group label to open the menu.

The Track groups menu let you administer the bipeds in the mixer. Each biped you add to the Motion Mixer gets its own track group, a selection of biped parts.

Filter: Opens the track group filter dialog where you can customise the biped body parts that are included in a track group mix.

Add Track Group Above: Adds new track groups above the currently selected ones.

Add Track Group Below: Adds new track groups below the currently selected ones.

Add Layer Track: Adds a layer track at the top of the selected track groups.

Add Transition Track: Adds a transition track at the top of the selected track groups.

Delete All Clips: Clears the selected track groups of all clips and transitions.

Delete: Clears the selected track groups from the motion mixer.

7.13.3 Tracks Menu

The commands in the Tracks menu are only active when you have a track or tracks, selected in the Mixer. These menu commands are also available when you right-click a track in the Mixer window.

Add Layer Track Above: Adds a new layer track above the currently selected tracks.

Add Layer Track Below: Adds a new layer track below the currently selected tracks.

Add Transition Track Above: Adds a new transition track above the currently selected tracks.

Add Transition Track Below: Adds a new transition track below the currently selected tracks.

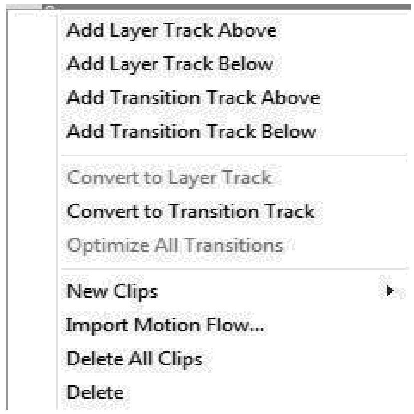

Fig. 7.7: Track Menu

Convert To Layer Track: Converts the selected transition tracks to layer tracks.

Convert To Transition Track: Converts the selected layer tracks to transition tracks.

Optimize All Transitions: All transitions on the track are optimized.

New Clips >From Files: Opens a dialog where you can choose one or more bip files to add to the selected track.

New Clips >From Reservoir: Opens a reservoir files dialog where you can choose one or more bip files listed in the reservoir.

Import Motion Flow: Allows you to import clips and transitions from a motion flow script to the selected track.

Delete All Clips: Deletes all the clips residing on the selected track.

Delete: Deletes a selected track or tracks.

7.13.4 Clips Menu

The Clips menu is active when a clip is selected or when you right-click a clip in the Mixer. Some menu commands are not available when multiple clips are selected.

Add Time Warp: Applies the ability to be time warped to the selected clips.

Remove Time Warp: Removes the ability for clips to be time warped and removes any existing time warping from selected clips.

Tile View: Tiles the selected clip along the width of the motion mixer.

Tile Range: Tiles the selected clip along the range of the active time segment.

Remove Trim/Scale: Removes the trim/scale from the selected clip or clips.

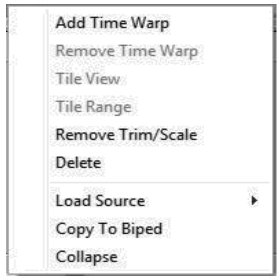

Fig. 7.8: Clip Menu

Delete: Deletes a selected clip or clips from a track.

Load Source >From File: Opens a dialog where you can choose a new bip file to replace selected clips. After selecting the new clip, the mixer clip source options dialog is displayed.

Load Source >From Biped: Opens the copy biped animation to clip dialog, where you can choose a biped from which to copy animation to selected clips.

Load Source >From Reservoir: Opens the reservoir file groups dialog, where you can choose a clip from the reservoir to replace selected clips.

Copy To Biped: Puts the clip's animation onto the base state of the selected biped, evident when not in mixer or any other mode. This option is available only when a single clip is selected.

Collapse: Saves a collapsed version of the selected clip to a new bip file. Collapsing removes all scaling, trims and time warps from the clip and prompts for a new bip file name for the collapsed version of the clip.

7.13.5 Transitions Menu

Select a transition track to make commands on this menu active. Right clicking a transition also opens this menu.

Edit: Opens a mixer transition editor dialog that is similar to the transition editor accessed from the motion flow rollout.

Optimize: Optimizes the selected transitions. this uses optimization algorithms similar to those in motion flow.

Convert To Loopable Clip: Allows you to create a loopable clip from a transition between two clips that are clones of one another.

Like an audio mixer where you add music tracks and use fades and blends to transition between tracks, the Motion Mixer allows you to mix motion clips. The Motion Mixer toolbar offers commands that you use to add and delete bipeds to and from the mixer, modify clips and change the way tracks in the mixer are displayed.

Fig. 7.9: Motion Mixer Toolbar

Deletes a selected biped from the Motion Mixer window

Select: Letyou select bipeds, track groups, tracks and clips.

Move Clips: Allows selection and movement of bipeds and track groups, keeping clips and transitions intact.

Slide Clips: Allows horizontal movement of clips on the same track or vertical movement of clips from one biped's track to another biped's track.

Offset: Records how many frames have been displaced.

Frame: Displays the frame number under the cursor during interactive translations, such as stretching a clip or editing a time warp.

Trim Clips: Clips can be trimmed from their original lengths interactively.

Editable Time Warps: Clips can be interactively time warped, given that they have had a time warp applied.

Drag Gable Tracks: Enables vertical movement of tracks with clips.

Lock Transitions: When lock transitions is turned off (the default), moving a clip or changing its length on a transition track affect the lengths of transitions around the clip.

Set Range: Matches the active segment's start and end times to the extents of the mix.

Pan: Pans the motion mixer display horizontally and vertically.

Zoom Extents: Stretches or shrinks the mix to fit in the current motion mixer display.

Zoom: Allows horizontal stretching and shrinking of the display of the mix.

Zoom Region: Zoom into a portion of a track by dragging a region selection around that part of a track.

Snap Frames: A Toggle That Sets The Motion Mixer To Snap All Adjustments To Single Frames.

Snap Clips: A toggle that causes clips residing on the same track to snap together.

Preferences: Opens the mixer preferences dialog, where you can change display settings for clips, transitions and frames.

Reservoir: Opens the reservoir dialog.

Horizontal: This button is available when the weighting button on the motion mixer toolbar or on a track group is active.

Vertical: This button is available when the weighting button on the motion mixer toolbar or on a track group is active.

Horizontal Vertical: This button is available when the weighting button on the motion mixer toolbar or on a track group is active.

Weight Mode: A toggle that allows you to work with weight curves. weight curves are useful for making smooth blends between tracks.

Study Notes

Assessment

1. How many menus are contained at the top of the Motion Mixer window?
2. How many icons are there on the Motion Mixer toolbar?

Discussion

Use motion mixer menu with biped animated file.

7.14 Summary

Adjusting Biped Balance inthe Mixer

By default, the Mixer compensates for differences in upper and lower body motion by making slight alterations to the spine and pelvis motions.

Filtering Mixer Tracks

There are two steps involved in filtering with track groups:

- Create additional track groups as needed in the Mixer.
- Filter each track group (set it to use some body parts but not all) and name the track group appropriately.

Adjusting Track Weight

Each track has one or more weight curves that you can use to mix motion from several tracks to varying degrees. The weight curve determines how much a specific track contributes to the motion within the track group.

Transition Track

This Is a motion mixer track that allows us to stack clips on top of one another and to create automatic transitions between them.

Layer Track

This Is amotion mixer track for a series of motions that do not require transitions between them.

Mixer Preferences Dialog

The Motion Mixer Preferences dialog let us make changes to display settings for clips, transitions and frames.

Show / Hide Group

These settings affect how clips appear in the motion mixer tracks.

Frame Display Group

These settings affect how clip boundaries and transition in/outpoints appear in the Motion Mixer.

Interpreting Clip Names

When you load a clip into the Mixer for the first time, the clip name is followed by the number 1. If you clone or load the same clip to another part of the Mixer, the clip will display the same number or a different number depending on whether the new clip is an instance or an adaptation of the original clip.

Instance

In 3ds max, an instance is a interchangeable clone of the original object.

Creating A Motion Flow Script

To create a script, add clips to the Motion Flow Graph, then click Define Script in the Scripts section of the Motion Flow rollout and click a sequence of clips in the Motion Flow Graph.

Motion Mixer Menus

The Motion Mixer interface contains five menus located at the top of Motion Mixer window.

7.15 Self-Assessment Test

Broad Questions

1. What is Motion Mixer?
2. How does Motion Mixerwork?
3. What are Layer Track and Transition Track?
4. Discuss Motion Mixer Menus.

Short Notes

a. Balance in motion mixer

b. Track weight

c. Layer track

d. Shared Motion Flow

e. Transitions

7.16 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy

2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov

3. Animation with character studio 3, Michele Bousquet

4. The Animator's Motion Capture Guide: Organising, Managing, Editing, Matt Liverman

5. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese

6. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

7. Understanding Motion Capture, Alberto Menache

Assignment

Use Motion mixer to create realistic freeform animation.

Unit 2 Layers and Workbench

Learning Outcome

After going through this unit, you will be able to:

- Use layers rollout
- Practise docking and working with the workbench
- Analyze, Fix & select panel
- Explain Analyzers group
- Experiment with Curve view and how to fix curves
- Navigate the workbench & the curve view

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

8.1 Introduction to Layers

8.2 Layers Rollout

8.3 Understanding the Workbench

8.4 Working with the Workbench

8.5 Analyze Panel

8.6 Analyzers Group

8.7 Curve View

- 8.7.1 Filters panel
- 8.7.2 Filters group
- 8.7.3 Blurring, smoothing and boosting parameters
- 8.7.4 Key reducer

8.8 Fix Panel

- 8.8.1 Fixer Parameters

8.9 Fixing Curves

8.10 Navigating the Workbench

8.11 Navigating the Curve View

8.12 Docking the Workbench

8.13 Select Panel

8.14 Summary

8.15 Self-Assessment Test

8.16 Further Reading

8.1 Introduction to Layers

With layers,you can add animation sequences on top of the original biped animation. This is useful and powerful tool for making global motion changes to an entire animation.

In CS,layers are similar to their counterparts in page layout and other composition programs. All of the information that is not blocked but by subsequent layers it is allowed to show through. Biped displays stick figures to represent animations on the layers other than active one. The title of the layers is displayed in the layer roll out as it can be named.

Controls in the Layers rollout allow you to add layers of animation above the original biped animation. This is a powerful way of making global changes to your character animation. For example, simply add a layer and rotate the spine forward at any frame and a run cycle becomes a crouched run. The original biped motion is kept intact and can be viewed by switching back to the original layer. Layers can be viewed individually or as a composite of all the animation in all the layers. Layers behave like a freeform animation; the biped can adopt any position.

8.2 Layers Rollout

The screen shot and various options of layers rollout are discussed below:

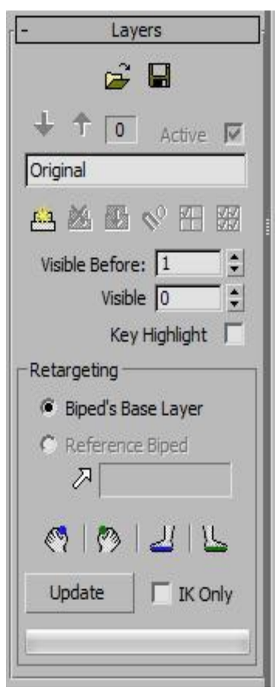

Fig. 8.1: Layer Rollout

Next-Previous Layer: Navigate through the layers using the up and down arrows.

Level: This field displays the current layer (level).

Active: Toggles the displayed layer on and off.

Name Field: Type a name to easily identify a layer.

Create Layer: Creates a layer and the level field increments.

Delete Layer: Deletes the current layer.

Collapse Layers: Collapses all the layers into layer 0.

Snap Set Key: Snaps the selected biped part to its original position in layer 0 and creates a key.

Activate Only Me: View the animation in the selected layer.

Activate All: Activates all the layers.

Visible Before: Sets the number of preceding layers to display as stick figures.

Visible After: Sets the number of succeeding layers to display as stick figures.

Key Highlight: Displays keys by highlighting the stick figures.

Study Notes

Assessment

1. What can add animation sequences on top of the original biped animation?
2. Write the names of Layers Rollout options.

	Discussion

1. Make global changes by using Layers from the given path:
2. Select the biped>motion panel>Layers rollout.

8.3 Understanding the Workbench

The Workbench is a curve editor customised for use with character studio. It provides specialised tools for selecting and displaying curves and for locating and fixing errors and discontinuities in motion. It is a visualisation tool that allows you to see and manipulate quaternion function curves represented as ruler angles. In addition, you can see curves for the position of a biped body part in any coordinate space.

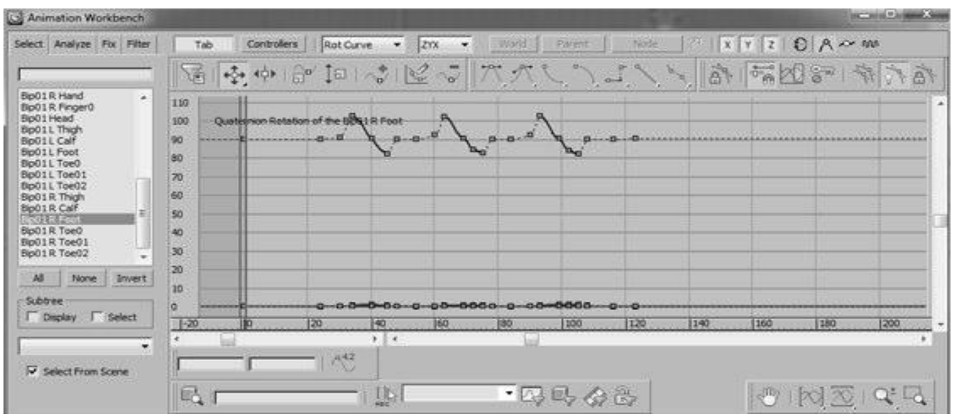

Fig. 8.2: Workbench Window

The Workbench automatically limits selections to just biped body parts and scene objects related to that biped. You can analyze these for errors using a variety of detectors and fix them using the provided fixers. You can also apply filters to perform operations on different biped body parts to generally affect the animation without error identification.

Function Curve editing for Biped is also available in the 3ds max Track View –Curve Editor and in the expanded track bar, but without the specialised Workbench tools.

Especially when working with imported motion capture data, you might find that curve editing is difficult using the standard 3ds max tool set. This is because you might have a key on every frame, so curve manipulation becomes cumbersome and awkward. It is difficult to visually pinpoint where the trouble spots are located. The Animation Workbench offers automatic functions to reduce keys or apply filters to the motion curves to smooth animation.

	Study Notes

	Assessment

1. Select a biped body part>Motion panel>Biped Apps>Workbench button.
2. Is this the correct path?
3. You can analyze these for errors using a variety of detectors and fix them using the provided fixers.(True / False)

	Discussion

Work on biped function curve by using Workbench tool.

8.4 Working with the Workbench

The Workbench is a customised version of Track View that you use for correcting and improving biped animation. It extends the functionality of existing curve editors by giving you different options for visualising and manipulating curves and provides filters to perform general rotation, position and other biped-specific operations. Curves can be analyzed for error conditions and filters applied to the identified key frames or selected biped tracks can be filtered to generally improve the motion of a track without errors.

	Study Notes

	Assessment
1. The Workbench is a customised version of Track View.(True / False) 2. What is the use of a Workbe nch?	

	Discussion
Follow the sequence below: 1. Create a biped and sel ect upper spine link. 2. Set a key at frame at 0. 3. Go to frame at 10, rota te the spine link 30 degrees in the local Z axis, then set a key. 4. Open the Animation Workbench. 5. Select the biped's hea .	

8.5 Analyze Panel

The Analyze panel provides tools to evaluate the curves for the selected biped parts and review them for certain error conditions. It can spot spikes and noise in the curves and locate specific key frames that are responsible for discontinuous motion. The errors are displayed as brown lines over the curves and are also listed at the bottom of the Analyze panel. You can then use the Fix panel to automatically fix errors or you can fix errors by manually adjusting keys and curves in Curve view.

Parts To Analyze: These options choose which parts to analyze:

- Display Curve Part: When this is turned on, the curve displayed is analyzed.
- Selected Parts: When this is turned on, the parts selected in the list or View port are analyzed. Use this when you want to analyze an entire biped without displaying all of the curves in Curve View.

Time To Analyze: Sets the range to be analyzed. You can choose either:

- Entire Animation: Analyzes the entire animation.
- Active Time Segment: Choose this to use the active time segment, as set by the 3ds max Time Configuration dialog.
- From / To: These values let you specify a range with a particular start and end frame.

Study Notes

	Assessment
1. Which option chooses the parts to analyze? 2. Entire Animation option functionsAnalyzes the entire animation. (True / False)	

	Discussion
Study the Analyze Panel while doing animation of biped and working with motion flow and mixer.	

8.6 Analyzers Group

Analyzers drop-down list: Letyou choose which analyzer will be used to evaluate the curves. Each analyzer can present its own individual settings. The default choices are Noise Detector and Spike Detector.

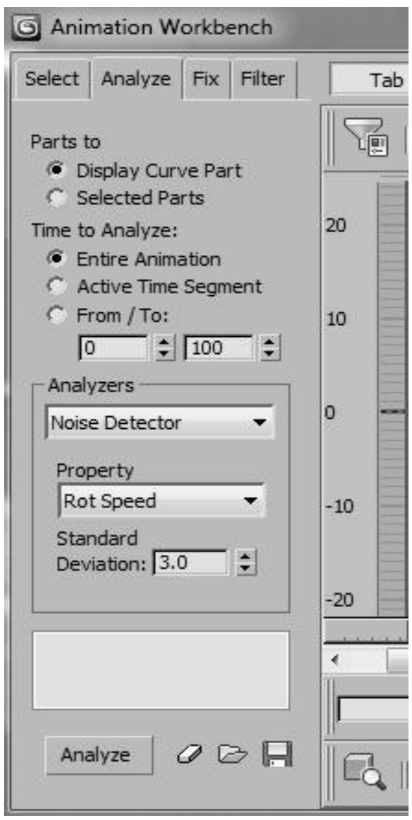

Fig. 8.3: Analyze Panel

- Noise Detector: Finds any large change in the animation, either rotational or positional as determined by the standard deviation value.
- Spike Detector: Finds any large change in the animation that also contains a change in direction (in quaternion space or position space). Can operate on all curves in the animation, regardless of what is currently visible in the Workbench. The analysis can be adjusted for Standard Deviation, which is the degree to which the animation departs from its overall pattern.
- Knee Wobble: Finds knees that wobble or shake when a foot is planted. Uses Frame and Fluctuation parameters to determine what a wobble error is.
- Knee Extension: Finds knees that overextend when a foot is planted. Uses a Knee Angle parameter to determine extension errors.

Property Drop-Down List: Let you choose the criterion that the noise detector uses to evaluate the curves errors. Use rotational (rot) properties to analyze rotational errors; use position (pos) properties to analyze move transform errors.

Options in this drop-down list include:

- Rot Speed: Looks for noise in the speed of the rotational angle.
- Rot Accel: Looks for noise in the acceleration of the rotational angle.
- Rot Jerk: Looks for noise in the jerk of the rotational angle.
- Pos Speed: Looks for noise in the speed of the position.
- PosAccel: Looks for noise in the acceleration of the position.
- Pos Jerk: Looks for noise in the jerk of the position.

Standard Deviation: Letyou set the degree to which the animation can depart from its overall pattern.

Error Results List: Displays all errors that the analyzer finds.

Analyze: Click to perform the analysis.

Clear Results: Deletes the results of the latest analysis.

Load Analysis File: Loads the results of a previous analysis.

Save Analysis: Saves the results of the latest analysis.

Study Notes

Assessment

1. Which option finds any large change(s) in ananimation?
2. How many options are there in Property drop-down list?

Discussion

Analyze a file of biped animation and save it.

8.7 Curve View

8.7.1 FILTERS PANEL

Filters are simply operations that can be performed to different biped body parts. They are similar to fixers, but they operate over an interval of time rather than the results of the last analysis. Thus, you can use a filter without analyzing.

Certain filters share parameter types and functionality as fixers, though the values are not shared and are distinct for each filter. Use a filter whenever you want to perform a general operation over a body parts motion, like smooth out or boost up some noise."

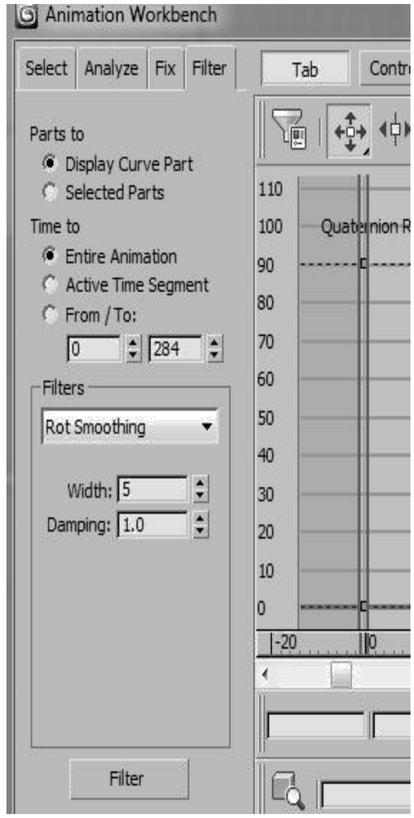

Fig. 8.4: Filter Panel in Workbench

Parts To Filter: Sets The Filter To Act On Either The Display Object Or The Entire Selection Of Objects.

- Display Curve Part: Sets the filter to act on the displayed object curves.
- Selected Parts: Sets the filter to act on the active selection. Especially useful when working on the whole biped.

Time To Filter: Sets The Range To Be Filtered To The Entire Biped Animation, The Active Time Segment or A Custom Range Of Frames.

- Entire Animation: Sets the time to filter to be the complete biped animation (disregarding the active time segment).
- Active Time Segment: Sets the time to filter to be the scene active time segment. You set the active time segment in the 3ds max Time Configuration dialog.
- From / To: Sets the time to filter to a custom range of frames.

8.7.2 Filters group

Filters List: Choose the filter to use from this drop-down list.

The available filter types include smoothing, blurring, boosting, key reduction and subanims.

- Rot filters work in quaternion rotation space and modify the quaternion of the specified animation tracks.
- Pos filters work in the specified positional coordinate system and modify the positions of the animation tracks.
- Blurring: Uses basic Gaussian filters that take a weighted average over the width. Smoothing filters, on the other hand, are much better than blurring filters for keeping the general shape of the track or curve. They affect only areas that have big changes. The drawback of the smoothing filters is that they do not change the curve as dramatically as the blurring filters do, so sometimes you'll need to run the smoothing filter multiple times to smooth out a particularly noisy area.

Adv Rot Smoothing works even better than the normal angular smoothing filter when it comes to modifying only large changes and not small ones.

- Boosting: Boosting filters are the opposite of blurring filters. They increase, rather than decrease, changes in the track.
- Sub Anims: The Sub Anims filter manages sub-animation of biped objects.
- Key Reducer: Creates tracks with fewer keys, by removing certain keys based on tolerance and key spacing parameters.
- Knee Wobble: Corrects knees that wobble or shake when a foot is planted.
- Knee Extension: Corrects knees that overextend when a foot is planted.

8.7.3 Blurring, Smoothing andboosting parameters

Width: Width is the size of the filter kernel width in frames. It tells you how much of the animation is taken into effect when filtering a specified key frame.

Damping: The Damping Value Changes How Effective The Filter Should Be. Thehigher value, the more dramatic the change is. A damping value of 1.0 is normal filter behaviour

Enable: Turns position, rotation and scale subanims on and off for the selected biped parts.

Collapse: Adds the subanim animation of the selected biped part to that part's transform controller.

Do not Delete: Maintains the subanim in the list as it's collapsed onto the biped.

Per Frame: Sets keys at every frame of the collapsed controller.

The Sub Anims filter tools are also available from the Motion panel. You can assign controllers to a biped subanim and then collapse it by right-clicking and choosing Properties. The difference between using this in the Motion panel and in the Workbench is that you can apply subanims to multiple biped objects in one-step when using the Workbench filter.

8.7.4 Key Reducer

The screen shot and various options of key reducer are discussed below:

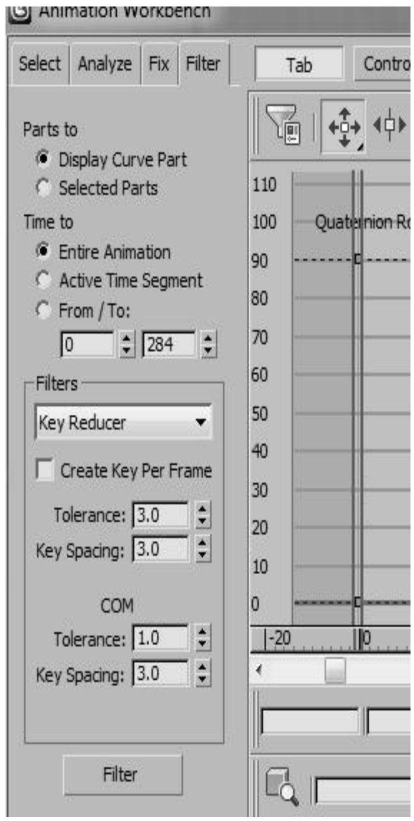

Fig. 8.5: Key Reducer Parameters in Filter Panel

Create Key Per Frame: When on, the filter creates a key per frame for every selected track.

Tolerance: Sets the maximum angular or positional deviation for a track.

Key Spacing: Sets the minimum number of frames between keys.

COM Parameters: These tolerance and key spacing settings affect key reduction only on specified center-of-mass (com) tracks (horizontal, vertical or rotational).

Filter: Click to apply the active filter to the selected tracks.

Study Notes

Assessment

1. _________ are simply operations that can be performed to different biped body parts.
2. Curve view does not use soft-selection. (True / False)

Discussion

Follow the sequence below and notice how there are no curves in the workbench because the head doesn't inherit the spine link's rotation and doesn't have an internal rotation of its own:

1. Create a biped and select its upper spine link.
2. Set a key at frame 0.
3. Go to frame 10 and rotate the spine link 30 degrees in the local Z-axis.
4. Open the animation workbench.

5. Select the biped's head

8.8 Fix Panel

The Fix panel provides access to the tools that can be used to automatically fix the errors found by the Analyze panel. There is a variety of methods available to automatically correct errors found in the curves. Smoothing, blurring and removing keys are all options.

Analyze Results error list: Displays all the errors the analyzer found for the selected body parts. The frame number of the error precedes the name of the Biped object. Clicking the error once displays a yellow line at that frame in the Curve View. Clicking it twice moves the current frame to match the error frame number: the View ports display that frame as well.

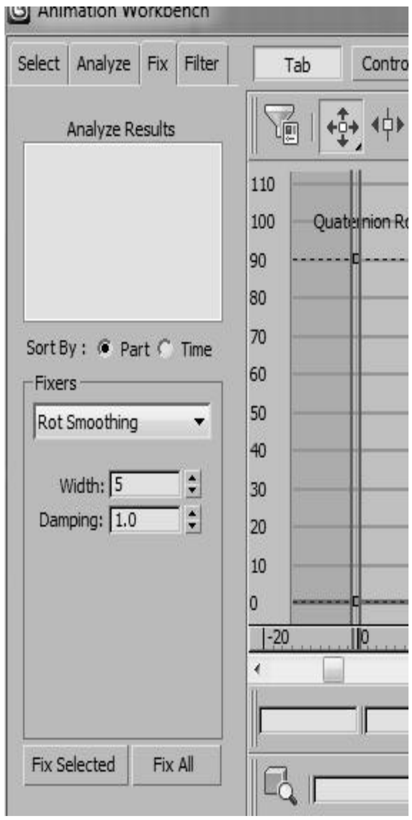

Fig. 8.6: Fix Panel

Sort By: Letyou change the display of the error analysis results.

- Part: Displays all the errors for each part listed together.
- Time: Displays all the errors sequentially, by frame.

Fixers: Determines the method used to attempt to correct the errors found by the analyzer. In general, try to match the fixer to the analyzer property. For example, if you have selected a noise detector with rot speed, then choose a fixer with rot in the name as well. The exception to this would be when it is obvious that you would prefer to remove the keys rather than modify them. In that case, choose a remove keys fixer.

Fixer options include:

- Rot Smoothing: Corrects rotational errors by smoothing the curve. Can be repeated on the same track for greater effect. Slower than blurring, but keeps more detail of the curve.
- Rot Blurring: Corrects rotational errors by blurring the curve. Good if you just want to keep the general shape of the animation, but do not want to keep the details. May remove too much detail in the animation.
- Adv Rot Smoothing: Works even better than the normal smoothing filter when it comes to only modifying large changes. Can be repeated on the same track for greater effect. It is the slowest filter, great at keeping minute details, which can be very important, especially with motion-capture data when you want to keep nuances.
- Pos Smoothing: Corrects move transform problems by smoothing the curve. Can be repeated on the same track for greater effect. Slower than blurring, but keeps more detail of the curve.
- Pos Blurring: Corrects positional problems by blurring the curve. Good if you just want to keep the general shape of the animation, but do not want to keep the details. May remove too much detail in the animation.
- Remove Keys: Fixes errors by deleting keys based on an interval setting.
- Knee Wobble: Fixes knees that wobble or shake when a foot is planted. Uses a Knee Angle value as criteria for error status.
- Knee Extension: Fixes knees that overextend when a foot is planted. Uses a Fluctuation value as criteria for error status.

Individual fixers display different parameters. These include:

- Width: Determines how much of the curve is affected around the key frame.
- Damping: Determines how the fix is blended into the existing curve.
- Delete Keys: Allows for selective key removal based on Interval Width.
- Interval Width: Determines the number of frames around the error to consider when deleting keys.
- Knee Angle: Sets the rotation angle to determine what constitutes knee extension errors.
- Frames: Determines the interval to consider for fluctuation evaluation.
- Fluctuation: Establishes the amount of change allowed before knee wobble is identified.

Fix Selected: Applies the fixer operation to the selection in the analyze results error list.

Fix All: Applies the fixer operation to all the errors, whether they are selected in the analyze results error list or not.

Study Notes

Assessment

1. Select a biped body part>Motion panel>Biped Apps rollout>Workbench button>Fix panel- is that the correct path?
2. How many options are there in the Fixer parameter?

Discussion

Follow the sequence given below:

1. Click to highlight the error in the Analyze Results list.
2. Choose the Fixer type
3. Click Fix Selected.
4. Observe the change in the Curve View.
5. Play the animation (error has been corrected).
6. If the error is still visible, try changing the parameters for the fixer or choose a different fixer.

8.9 Fixing Curves

After you have selecting curves and analyzing them for error, you can use the tools found on the Fix panel to process the curves and reduce the errors.

The fixes are determined by which type of fixer you choose and the parameters you set for that fixer. Clicking Fix Selected or Fix All at the bottom of the panel performs the Fix operation.

In general, fixes are made either by changing the position or value of a key or by removing the key. The basic fixing techniques involve smoothing, blurring, boosting or key deletion. This is similar to audio-editing software, where you view music as a waveform and then edit the waves in various ways to alter the sound. Similarly, the motion of the biped body parts, as defined by position and rotation tracks, can be evaluated for error conditions regarding speed, angle, acceleration or change of direction.

Of course, you can also fix curves manually. You can select the key on the curve and move it, using the standard Track View key buttons duplicated in the Workbench, such as Move, Slide, Scale or Delete Keys.

	Study Notes

	Assessment

State True /False.

1. You can also fix curves manually.
2. The basic fixing techniques involve smoothing, blurring, boosting or key deletion.

	Discussion

Analyze the curve and use Fixing curve.

8.10 Navigating the Workbench

The Animation Workbench, a customised version of Track View, uses some of the standard Track View controls and adds new ones of its own. The areas of the Workbench interface include:

- The Tab panels: Select, Analyze, Fix and Filter
- The Curve view, with Track View toolbars for key selection, manipulation and view navigation.
- The Workbench toolbar, with tools for choosing Coordinate space, display of sub-animations and tools to hide the Tab area and controller list.

Each section of the Workbench User has specific navigation techniques.

	Study Notes

	Assessment

State True or False.

1. The Animation workbench is a customised version of Track View
2. There are three tabs Analyze, Fix and Filter.

	Discussion
Explain Navigating the workbench by using a biped animation file.	

8.11 Navigating the Curve View

Use the standard 3ds max Track View navigation tools to adjust the view of curves in the Curve view window. Zoom, Extents Horizontal and Vertical and Pan is often used to get a better view of an entire curve or a portion of a curve. As a default, the curve view automatically displays the curve of whatever biped object is selected in the view port.

The Workbench window can be resized to make it easier to work with curves. You can float or hide toolbars to give you even more room. You can dock toolbars left and right as well.

	Study Notes

	Assessment
State True orFalse. 1. The Workbench window can be resized to make it easier to work with curves. 2. Zoom, Extents Horizontal and Vertical and Pan is used to get a better view of an entire curve or a portion of a curve.	

	Discussion
Explain the Navigating the curve view by using a biped animation file.	

8.12 Docking the Workbench

You can dock the Workbench in a view port. With the Workbench open, right-click the view port's label and choose Views > Extended, then choose Biped Animation Workbench. The open workbench docks in the view port.

	Study Notes

	Assessment

1. You can dock the Workbench in a view port. (True / False)
2. Follow the path given below
   a. With the Workbench open, right-click the view port's label and choose Views > Extended, then choose Biped Animation Workbench.
   b. Write your observations about the same.

	Discussion

Explain Docking the workbench view by using a biped animation file.

8.13 Select Panel

The Select panel of the Animation Workbench provides tools for selecting bipeds or biped components. The selected biped part's animation tracks can be manipulated using curves displayed in the Workbench or by using the Analyze, Fix and Filter panels to automatically identify errors and fix them.

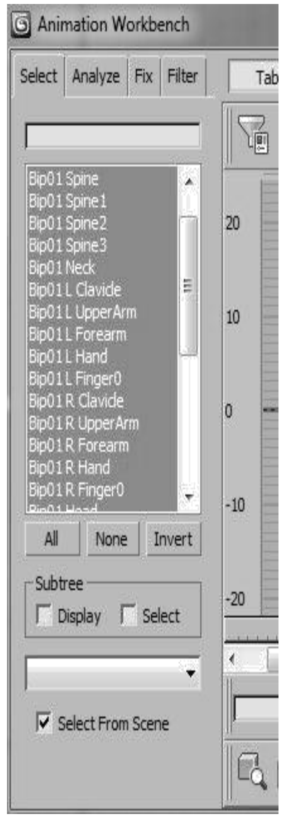

Fig. 8.7: Select Panel in the Workbench

Selection Field: Enter The Name Of The Biped Part You Want To Locate. That name (if found) will be highlighted in the selection list. This is useful when you cannot find an entry by scanning the list.

You can use the question mark and asterisk characters as wildcards, in order to select multiple objects at once.

Selection List: The selection list displays all the body parts of all the bipeds in the scene.

You can use the SHIFT, CTRL and ALT keys to build selection sets, just as you do in 3ds max.

All: Selects every entry in the list.

None: Clears the selection so nothing is highlighted.

Invert: Selects everything not highlighted in the list.

Display: Indents the list to show the biped hierarchy.

Select: When on, selecting one biped part selects both it and all of its children.

Named Selection List: When a named selection is created in the scene, the named selection becomes available

Select From View Port: When select from view port is turned on, you can click the biped body parts directly in the view port, rather than from the list. The curves are immediately displayed in the workbench curve view. This is handy to use if you do not know the name of the part you need to select.

Study Notes

Assessment

State True orFalse.

1. The Select panel of the Animation Workbench provides tools for selecting bipeds or biped components.
2. You can use the SHIFT, CTRL and ALT keys to build selection sets.

Discussion

Select a biped body part>Motion panel>Biped Apps>Workbench button>select panel ---- Follow it to select biped or biped component.

8.14 Summary

LAYERS ROLLOUT

Controls in the Layers rollout allow us to add layers of animation above the original biped animation.

UNDERSTANDING THE WORKBENCH

The Workbench is a curve editor customised for use with character studio. It provides specialised tools for selecting and displaying curves and also for locating and fixing errors and discontinuities in motion.

WORKING WITHTHE WORKBENCH

The Workbench is a customised version of Track View that you use for correcting and improving biped animation. It extends the functionality of existing curve editors by giving you different options for visualising and manipulating curves and provides filters to perform general rotation, position and other biped-specific operations.

ANALYZEPANEL

The Analyze panel provides tools to evaluate the curves for the selected biped parts and review them for certain error conditions.

ANALYZERSGROUP

Analyzers drop-down list lets the user choose which analyzer will be used to evaluate the curves. Each analyzer can present its own individual settings.

FIX PANEL

The Fix panel provides access to the tools that can be used to automatically fix the errors found by the Analyze panel.

FIXING CURVES

After selecting curves and analyzing them for error, you can use the tools found on the Fix panel to process the curves and reduce the errors.

NAVIGATING THE WORKBENCH

The Animation Workbench, a customised version of Track View, uses some of the standard Track View controls and adds new ones of its own.

NAVIGATING THE CURVE VIEW

Use the standard 3ds max Track View navigation tools to adjust the view of curves in the Curve view window. As a default, the curve view automatically displays the curve of whatever biped object is selected in the view port.

DOCKING THE WORKBENCH

Use the standard 3ds max Track View navigation tools to adjust the view of curves in the Curve view window. Zoom, Zoom Extents Horizontal and Vertical and Pan is often used to get a better view of an entire curve or a portion of a curve. As a default, the curve view automatically displays the curve of whatever biped object is selected in the view port.

SELECT PANEL

The Select panel of the Animation Workbench provides tools for selecting bipeds or biped components.

8.15 Self-Assessment Test

Broad Questions

1. What is the use of the Workbench?
2. What are the different panels in the workbench? Give brief description of the panels.
3. What is the use of Layer Panel?

Short Notes

a. Animation Layers
b. Workbench
c. Curve View
d. Fixing curves

8.16 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Use Workbench to enhance animations already created.

Unit 3 Crowd and Delegates

Learning Outcome

After going through this unit, you will be able to:

- Explain Character Studio’s Crowd and Delegate Behaviours
- Use Crowd Animation
- Show how to simulate large number of character like group of birds, animals, human beings etc
- Practise on application of random motions on the crowd
- How to apply different behaviours to the crowd like avoid, wander, speed vary, surface arrive etc
- How to make teams of the crowd

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

9.1 Introduction to Crowd System and Delegate Helper

9.2 Geometry Parameters Rollout

9.1 Introduction to Crowd System and Delegate Helper

In crowd animation, a crowd system comprises the Crowd helper, one or more Delegate helpers, a Vector Field space warp and Motion Flow mode. These are used in combination to animate characters or other objects. The crowd system is used to animate and control a large number of bipeds or objects.

The Delegate is a special helper object used in crowd animation. It serves as an agent for motion created by a Crowd object and its behaviours. The Crowd object controls a delegate or delegates, whose motion can then be imparted to a biped or other object. Delegates cannot be rendered.

The delegate object is shaped like a pyramid. By default, the point of the pyramid indicates the forward direction, the delegate's local Y-axis.

The delegate object uses the following rollouts:

- Geometry Parameters Rollout
- Motion Parameters Rollout

9.2 Geometry Parameters Rollout

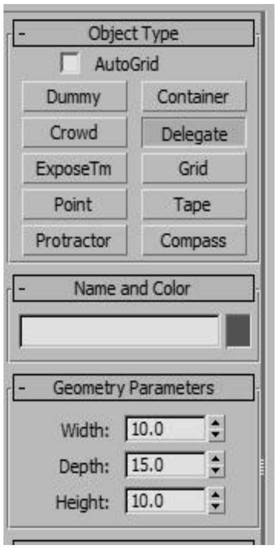

Fig. 9.1: Geometry Parameters Rollout

Use these parameters to modify the delegate object's size.

Width, Depth, Height: Sets the width, depth and height of the delegate object. These fields also act as readouts when you create the delegate.

	Study Notes

	Assessment
Crowd animations are used in combination to animate characters or other objects. (True / False) 1. The delegate object uses the rollouts. Name them.	

	Discussion
Create a crowd animation with delegate.	

9.3 Motion Parameters Rollout

The Motion Parameters rollout let you specify a Delegate object's characteristics, including speed, acceleration and other factors. It also let you associate the delegate with a biped.

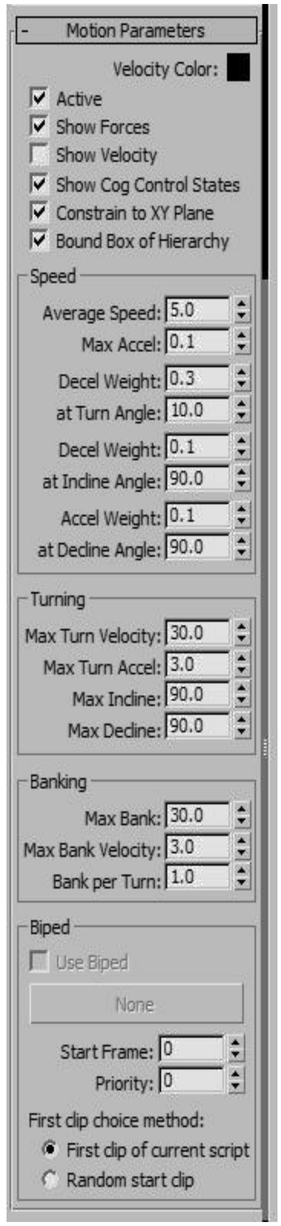

Fig. 9.2: Motion Parameters Rollout

Velocity Colour: When show velocity is on, uses the specified colour to draw a vector in the delegate's center during the simulation solution. The vector length indicates the delegate's relative speed.

Active: The delegate object is subject to control by a crowd object.

Show Forces: The forces being applied to a delegate by any applicable behaviour are drawn as vectors whose length indicates the extent of the forces and whose orientation shows the direction in which the behaviour is influencing the delegate to move.

Show Velocity: Uses the velocity colour (see above) to draw a vector whose length depicts the delegate's relative speed. This vector is visible only during the solution of the crowd simulation.

Show Cog Control States: During a solution, a text label appears next to the delegate showing the name of the cognitive controller state or transition that currently directs its behaviour, if any.

Constrain To XY Plane: The delegate remains at its initial height (position on the world z-axis) throughout the simulation.

Bound Box Of Hierarchy: When this option is on, the avoid behaviour uses the bounding box of the delegate and all of its children to perform its behaviour.

Average Speed: Specifies the delegate's baseline velocity in 3ds max units (or the current unit type) per frame.

Max Accel: Multiplied times average speed to determine the maximum acceleration.

DecelWeight: Specifies how much a delegate should slow down when turning.

At Turn Angle: Specifies the turn angle at which decel weight's full slowdown effect is applied.

Deceleration Weight: Specifies how much the delegate should slow down when moving at an upward slant.

At Incline Angle: Specifies the upward slant angle at which decel weight's full slowdown effect is applied.

Acceleration Weight: Specifies how much the delegate should speed up when moving at a downward slant.

At Decline Angle: Specifies the downward slant angle at which accel weight's full speedup effect is applied.

Max Turn Velocity: Specifies the maximum number of degrees a delegate can turn per frame. This applies both to heading and to pitch.

Max Turn Accel: Specifies how much the delegate's heading or pitch angle can change per frame.

Max Incline: Specifies the maximum number of degrees a delegate can turn upward at any given frame.

Max Decline: Specifies the maximum number of degrees a delegate can turn downward at any given frame.

Max Bank: Specifies the maximum number of degrees a delegate can bank.

Max Bank Velocity: Specifies the maximum number of degrees a delegate can bank per frame.

Bank Per Turn: The number of degrees the delegate will bank as a function of the turn angle at the current frame.

Use Biped: Associates the delegate with a biped (specified with the none button) and causes the delegate's speed to be determined by that of the biped's existing motion.

None (Label): Click this button and then select a biped to be associated with the delegate's motion.

Start Frame: Specifies the frame at which the biped's first clip will begin to play.

Priority: Sets the delegate priority, which determines the order of solution in biped/delegate simulations.

First Clip Choice Method: Determines which motion clip in the shared motion flow graph crowd initially uses to animate the biped linked with the delegate.

- First clip of current script: Uses the first clip in the biped's motion flow script, if a script exists. If this option is chosen, but there is no script, an error message is generated.
- Random start clip: Uses the random start clip or clips specified in the shared motion flow graph, if random start clips have been designated. If this option is chosen, but no random start clips have been designated, an error message is generated.

Study Notes

	Assessment

1. The delegate object is subject to control by a Crowd object. Is that the function of Active option from motion parameters rollout?
2. Write the motion parameters rollout options.

	Discussion

Create Panel>Helpers>object type rollout>Delegate>Motion parameter rollout

Use this path to study the motion parameter rollout on your biped animation.

9.4 Priority Rollout

The Crowd system uses the Priority rollout settings when solving a simulation involving bipeds associated with delegates. The Priority parameter is a positive integer assigned by the user to a delegate. When priorities are used, the Crowd simulation computes one biped at a time, based on its priority setting from lowest to highest; that is, a lower Priority setting means a higher priority. If the priorities of two biped/delegates are the same, the computation order of those two biped/delegates is randomly determined.

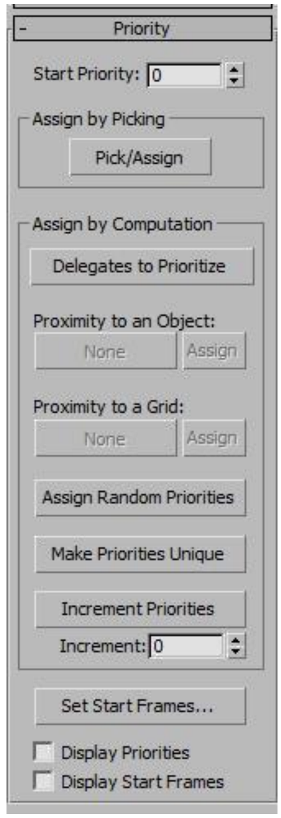

Fig. 9.3: Priority Rollout for Crowd

Start Priority: Sets the initial priority value. Applies to the first four methods of setting priorities: assign by picking, proximity to an object, proximity to a grid and assign random priorities.

9.4.1 Assign by Picking Group

Pick/Assign: Letsyou assign successively higher priority values to any number of delegates by selecting each in turn in the view port.

9.4.2 Assign by Computation Group

This group provides five different methods for assigning priorities to delegates, plus a button for selecting delegates to be affected by these methods.

Delegates To Prioritize: Letsyou use the select dialog to specify delegates to be affected by subsequent use of other controls within this group.

Proximity To An Object: Letsyou assign priorities based on delegates' distance from a specific object.

Proximity To A Grid: Letsyou assign priorities based on delegates' distance from an infinite plane defined by a specific grid object.

Assign Random Priorities: Assigns random priorities to the selected delegates.

Make Priorities Unique: Ensures that all delegates have unique priority values.

Increment Priorities: Increments the priorities of all selected delegates by the increment value.

Increment: Sets the value by which the increment priorities button adjusts delegate priorities. Use a negative increment value to decrement priorities.

Set Start Frames: Opens the set start frames dialog, for setting start frames based on assigned priorities.

Display Priorities: Enables the display of assigned priority values as black numerals attached to the delegates.

Display Start Frames: Enables the display of assigned start frame values as black numerals attached to the delegates.

Study Notes

Assessment

1. The _________uses the Priority rollout settings when solving a simulation involving bipeds associated with delegates.
2. When priorities are used, the Crowd simulation computes one biped at a time, based on its priority setting from lowest to highest; that is, a lower Priority setting means a higher priority. (True / False)

Discussion

Select Crowd>Modify panel>Priority rollout. Use this path and apply it on biped crowd animation.

9.5 Set Start Frames Dialog

When you include bipeds in a crowd simulation using a shared motion flow, you usually do not want them all walking in lockstep formation. You can avoid this by setting different start frames to vary the animation frame at which each biped starts moving using its initial motion clip. In most cases, you would set start frames in the same order as priority, so you do not get bipeds with earlier start frames stuck behind bipeds with later start frames. The Set Start Frames dialog let you automatically assign start frames to delegates in the same order as priority.

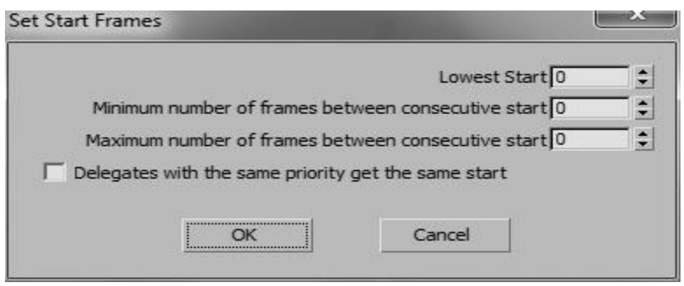

Fig. 9.4: Set Start Frames Dialog

Lowest Start Frame: Sets the start frame assigned to the delegate with the lowest priority setting.

Minimum Number Of Frames Between Consecutive Start Frames: The smallest value the software will use to increment assigned start frames.

Maximum Number Of Frames Between Consecutive Start Frames: The largest value the software will use to increment assigned start frames.

Delegates With The Same Priority Get The Same Start Frame: The software assigns the same start frame to any delegates with identical priority settings.

OK: Assigns start frame values to selected delegates based on the dialog settings and priority order and closes the dialog.

Cancel:Closes the dialog without changing start frame values.

	Study Notes

	Assessment

1. Name the option that Sets the start frame dialog.
2. The Set Start Frames dialog let you automatically assign start frames to delegates in the same order as priority. (True / False)

	Discussion

Select crowd>modify panel>priority rollout>set start frames button. Use the path and study it by doing practically.

9.6 Edit Multiple Delegates Dialog

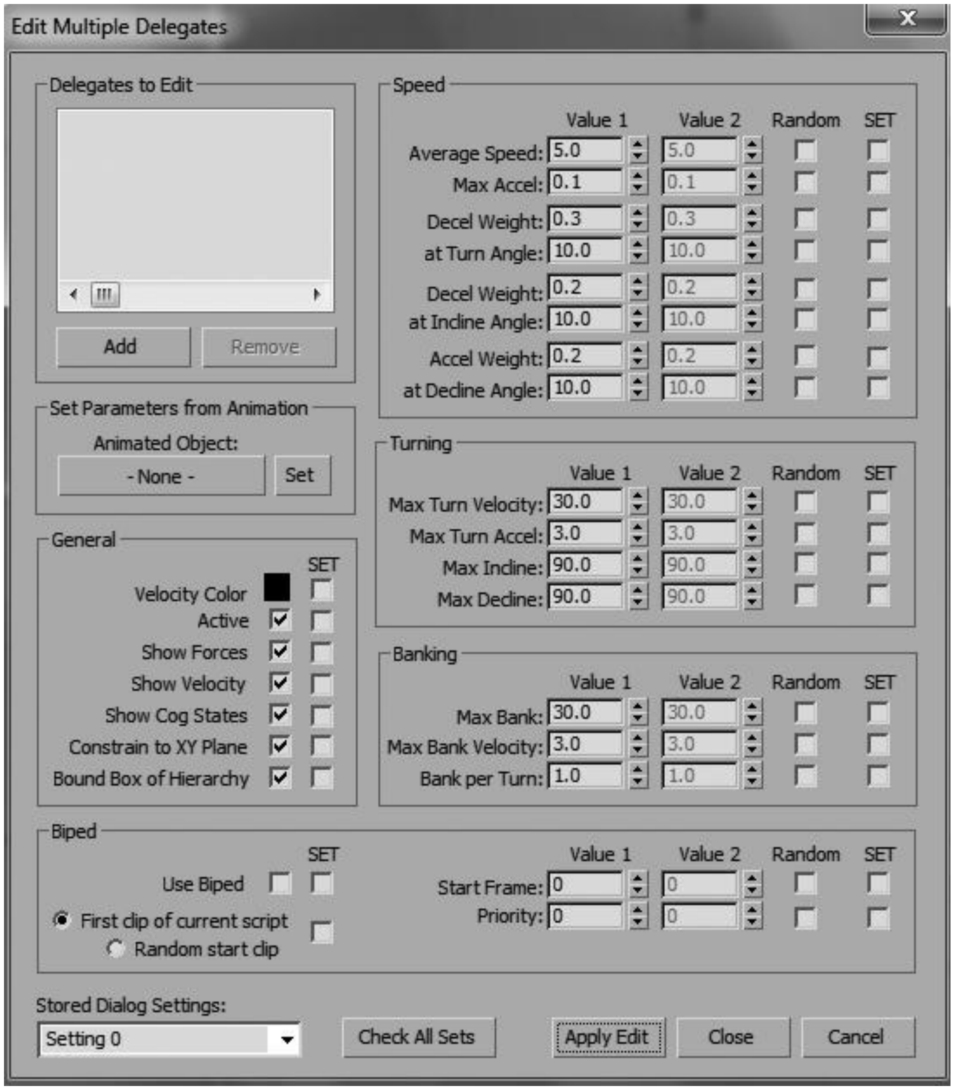

Fig. 9.5: Edit Multiple Delegates Dialog

The Edit Multiple Delegates dialog let you define groups of delegates and set parameters for them. You can create and store up to 10 different configurations or settings combinations; each consists of one or more delegates and settings for the delegates.

The parameters are mostly the same as those found in the delegate object's Motion Parameters rollout, with the following exceptions and additions.

- Each setting has an associated SET check box, which let you determine whether the setting has any effect.
- Each numeric parameter has two Value settings and an associated Random check box,

which let you specify a random value within a specified range for each member of the group.

Add: Click This Button and Then Choose Delegates To Add From The Select Dialog.

Remove: To Remove Delegates From The List, First Choose The Names Of Those To Delete In The List Box (Drag To Choose Two Or More Contiguous Names or Use CTRL-Click To Choose Non-Contiguous Names) and Then Click Remove.

9.6.1 Set Parameters from Animation group

Use this function to obtain motion parameters from an animated object and apply them to all specified delegates. It affects only Average Speed, Max Accel and the Turning parameters.

Because this one animation will set most of the parameters of the delegate, it should be representative of a whole range of motion of the delegate. For example, the object should turn and accelerate. The animation should be somewhat lengthy so that averages are calculated correctly.

Animated Object: Specifies an animated object. Click this button and then choose the object from the list in the select dialog.

Set: After specifying the animated object, click this button to apply its parameters to the delegate settings. also turns on the set check box for any affected parameters.

9.6.2 General group

Rather than numeric values, the settings in this group are on-off switches, except for the first, Velocity Colour. To change Velocity Colour, click the colour swatch, use the Colour Selector dialog to pick a new colour and then turn on the Velocity Colour SET check box. To change any other setting in the General group, click the check box to the right of the setting and then turn on the setting's SET check box.

These settings are the same as those found in the delegate object's Motion Parameters rollout.

9.6.3 Speed group

These parameters are the same as those found in the delegate object's Motion Parameters rollout.

9.6.4 Turning Group

These parameters are the same as those found in the delegate object's Motion Parameters rollout.

9.6.5 Banking Group

These parameters are the same as those found in the delegate object's Motion Parameters rollout.

9.6.6 Biped Group

These parameters are the same as those found in the delegate object's Motion Parameters rollout.

Stored Dialog Settings: Use this list to specify up to 10 different combinations of delegates and settings.

Check All Sets: Click this button to turn on all set check boxes.

Apply Edit: Click apply edit to implement all changed settings and exit the dialog.

Close: Click close to remember, but not implement, all changed settings and exit the dialog.

Cancel: Click cancel to forget all changed settings and exit the dialog

Study Notes

Assessment

State true or false.

1. Animated Object: Specifies an animated object.
2. Follow the path:Select Crowd >Modify panel >Setup rollout >Multiple Delegate Editing.

Discussion

Follow the path below :

1. Select the Crowd object and go to the Modify panel.
2. On the Setup rollout, click (Multiple Delegate Editing).
3. Optionally, in the dialog (bottom-left corner), choose a stored dialog setting to use from the 10 available settings.
4. If necessary, use the Delegates To Edit group box controls
5. Modify the remaining parameters
6. Click the Apply Edit button and exit the dialog.

9.7 Space Warp Behaviour

The Space Warp behaviour let you space warps, such as wind or gravity, influence a crowd simulation. You can use it to apply space warps in the Forces and Particles & Dynamics categories to crowd members.

In particular, use the Space Warp behaviour to tie delegates to a Vector Field space warp, so that they avoid penetrating an irregularly shaped object while following its contours.

None: Click this button and then select a space warp object.

Colour Swatch: This shows the colour used to draw the space warp force vector during the solution. Click the box to choose a different colour.

Display Force: When on, force exerted on the delegate(s) by the space warp behaviour is drawn in the viewports as a vector during the simulation solution.

	Study Notes

	Assessment

1. Space warps can use in the Forces and Particles & Dynamics categories to crowd members. (True / False)
2. _________the colour used to draw the Space Warp force vector during the solution.

	Discussion

Follow the path and work with space warp.Select Crowd >Modify panel >Setup rollout >Behaviours group >Choose Space Warp from the drop-down list.

9.8 Wander Behaviour

The Wander behaviour imparts a random motion to delegates, letting you simulate a meandering activity in which delegates move and turn in a haphazard manner. It works by randomly picking a new direction and then turning and moving in that direction. You can specify how often to pick a new direction, how far to turn and how fast or slow to turn while moving.

Time Period: Specifies How Many Frames Should Elapse Before A New Direction Is Chosen.

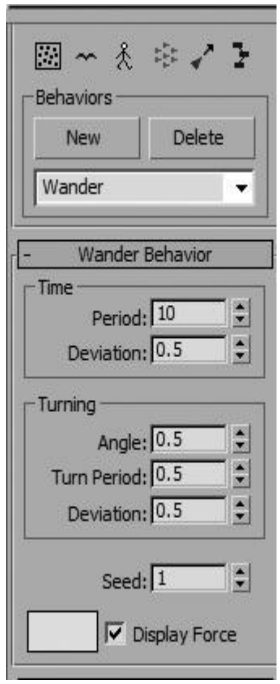

Fig. 9.6: Wander Behaviour Options

Deviation: Specifies The Maximum Amount By Which Period Should Vary.

Angle: Specifies how far to turn when changing direction.

Turn Period: Specifies how long over the current period it takes to turn.

Deviation: Specifies the maximum amount by which angle should vary.

Seed: specifies a seed value for randomizing the wander behaviour.

ColourSwatch: Shows the colour used to draw the wander force vector during the solution. Click the box to choose a different colour.

Display Force: When on, force exerted on the delegates by the wander behaviour is drawn in the viewports as a vector during the simulation solution.

	Study Notes

	Assessment

1. ___________ Specifies how far to turn when changing direction. (Angle/ Deviation)
2. What is the function of Wander behaviour?

	Discussion

1. Follow the sequence: Add Wander behaviour to the Crowd object. Change the default settings as desired.
2. Use Behaviour Assignments.

9.9 Scatter Objects Dialog

The Scatter Objects dialog of the Crowd helper object includes facilities for creating crowds by cloning objects, such as delegates. It also let you distribute the clones and other objects within a radial area, along a shape, across a grid object or surface or within a box or sphere. You can also specify various orientation and scaling options for scatter objects.

Object To Clone: Click This Button and Then Select An Object In The Scene To Be Cloned.

How Many: Specifies The Number Of Clones To Be Generated.

Copy/Instance/Reference: LetYou Specify How The Object Is Cloned.

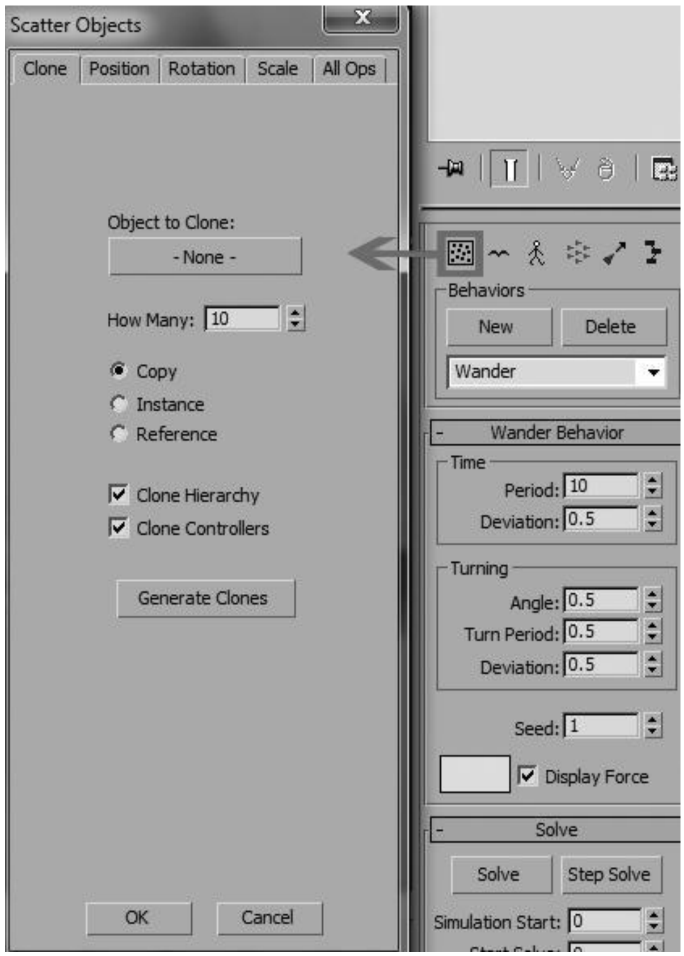

Fig. 9.7: Scatter Object Dialog Box: Clone Panel

Clone Hierarchy: When on, all objects linked to the selected object are cloned as well, with the hierarchical structure retained intact for each clone.

Clone Controllers: When on, any controllers (that is, animation) associated with the selected object are cloned as well.

Generate Clones: Click this button to create the specified number of clones of the object whose name appears on the object to clone button.

On Grid/Inside Sphere/Inside Box/On Surface/On Shape: Choose The Appropriate Item Before Selecting The Reference Object.

- On Grid distributes the scatter objects over the surface of a grid object.
- Inside Box and Inside Sphere distribute the scatter objects within the volume of a primitive box or sphere object, respectively.
- On Surface distributes the scatter objects over the surface of any render able object. For example, you can create a landscape object for use as a distribution surface by applying a Noise modifier to a patch grid.
- On Shape distributes the scatter objects along a shape object: a spline or NURBS curve. If the shape consists of more than one curve, Scatter uses the lowest-numbered curve (typically the first one added).

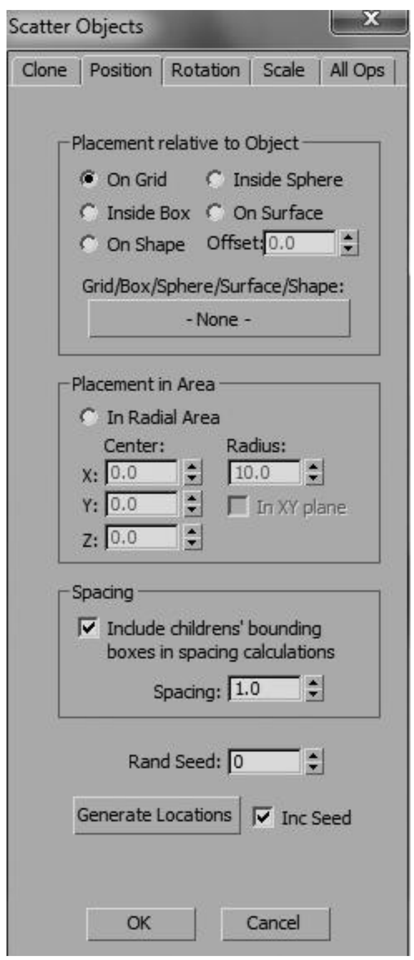

Fig. 9.8: Scatter Object Dialog Box: Position Panel

Offset: When using on surface, specifies a consistent distance above the surface (using surface normals) for distribution. available only when on surface is chosen.

Grid/Box/Sphere/Surface/Shape (None): Click this button and then select an object in the scene to be used as a reference object. Listed objects are limited to the chosen category.

Placement In Area Group

Contains options for positioning scatter objects in a radial area, without using a reference object

In Radial Area: Distributes the scatter objects randomly in a spherical or circular arrangement, using the remaining controls in this group box.

Center: Specifies the center of the distribution in world coordinates.

Radius: Specifies the maximum distance from the center within which objects are to be positioned.

In XY Plane: Specifies that objects are to be distributed on the world xy plane only, resulting in a disc-like array.

Spacing Group

Include Children's Bounding Boxes In Spacing Calculations: When on, all of a hierarchical scatter object's sub-objects are considered when determining spacing. When off, only the selected object is considered

Spacing: Specifies the minimum distance between scatter objects.

Rand Seed: Specifies a seed value for randomizing scatter objects' locations.

Generate Locations: Click this button to produce a set of locations for all scatter objects; that is, cloned objects or objects selected with the select objects to transform button.

Increment Seed: When on and you click the generate locations button, scatter adds 1 to the rand seed value and redistributes the objects using the new random seed.

9.9.3 Rotation Panel

Forward: +/-/X/Y/Z: Specifies which axis of the objects points forward, for use with the look at target option. When the + button is active, the default condition, the positive chosen axis is used. Click the + button to use the negative axis.

Up: +/-/X/Y/Z: Specifies which axis of the objects points upward; this axis is aligned with the worldZ-Axis. When the + button is active, the default condition, the positive chosen axis is used. Click the + button to use the negative axis.

Look From Group

Self/Selected Object: Determines the direction from which the objects look.

None (Label): When choosing selected object as the look from object, use this button to specify the "from" direction. Click the button and then select an object from which the objects are to look.

Look at Target Group

Current Orientation/Selected Object: Determines the direction toward which the scatter objects look.

None (label): Use this button to specify the "to" direction. Click the button and then select an object toward which the scatter objects are to look.

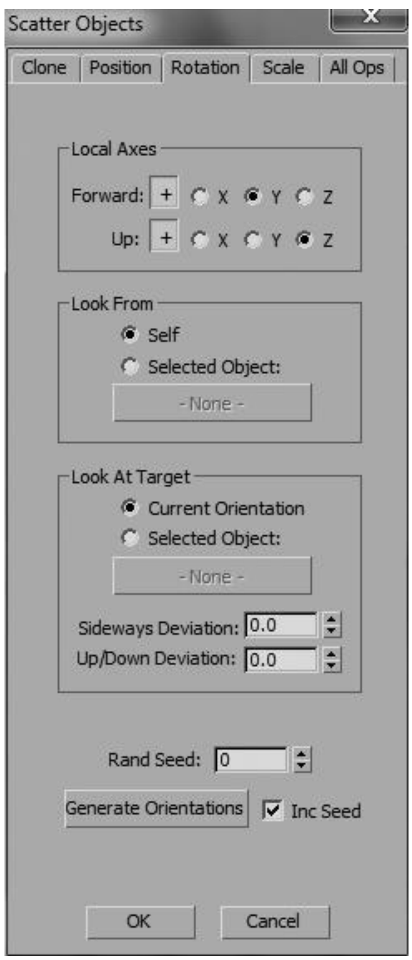

Fig. 9.9: Scatter Object Dialog Box: Rotation Panel

Sideways Deviation: Sets a maximum deviation angle in degrees for the objects' sideways orientation.

Up/Down Deviation: Sets a maximum deviation angle in degrees for the objects' up/down orientation.

Rand Seed: Specifies a seed value for randomizing the scatter objects' orientations, based on the deviation settings.

Generate Orientations: Click this button to produce a set of orientations for all scatter objects; that is, cloned objects or objects selected with the select objects to transform button.

Inc(Rement) Seed: When on and you click the generate orientations button, scatter adds 1 to the rand seed value and reorients the scatter objects using the new random seed.

9.9.4 Scale Panel

X Group

Scale: Sets scaling on the X-Axis as a multiplier.

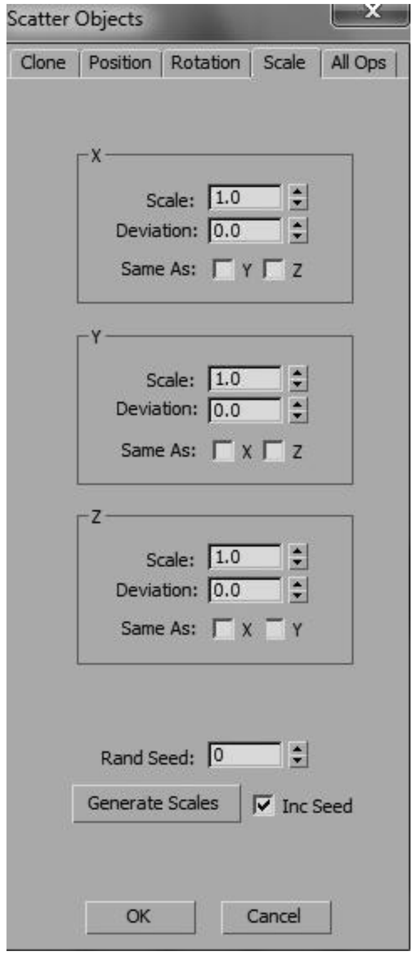

Fig. 9.10: Scatter Object Dialog Box: Scale Panel

Deviation: Sets the maximum factor for randomization of scaling. For each scatter object, deviation is multiplied by a random number between 0.0 and 1.0 and then added to the scale multiplier.

Same As Y/Z: Letsyou use the same scaling as on the y- or z-axis, whether explicit or randomized. When you specify an axis, the parameters group for that axis becomes unavailable.

Y Group

Scale: Sets scaling on the Y-Axis as a multiplier.

Deviation: Sets the maximum factor for randomization of scaling. for each scatter object, deviation is multiplied by a random number between 0.0 and 1.0 and then added to thescale multiplier.

Same As X/Z: Letsdyou use the same scaling as on the x- or z-axis, whether explicit or randomized. When you specify an axis, the parameters group for that axis becomes unavailable.

Z Group

Scale: Sets scaling on the z-axis as a multiplier.

Deviation: Sets the maximum factor for randomization of scaling. For each scatter object, deviation is multiplied by a random number between 0.0 and 1.0 and then added to the scale multiplier.

Same As X/Y: Letyou use the same scaling as on the x- or y-axis, whether explicit or randomized. When you specify an axis, the parameters group for that axis becomes unavailable.

Rand Seed: Specifies a seed value for randomizing the clones' scales, based on the deviation settings.

Generate Scales: Click this button to scale all scatter objects; that is, cloned objects or objects selected with the select objects to transform button.

Increment Seed: When on and you click the generate scales button, scatter adds 1 to the rand seed value and re-scales the scatter objects using the new random seed.

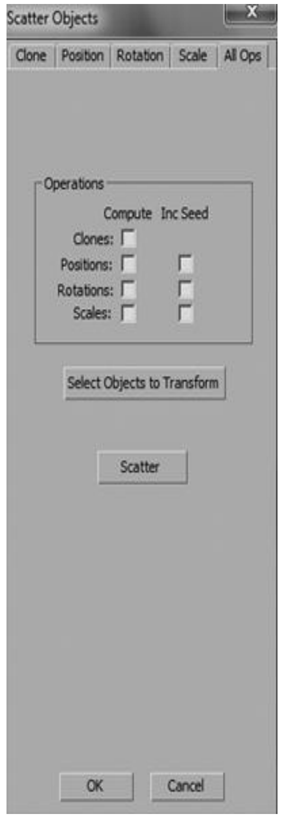

Fig. 9.11: Scatter Object Dialog Box: All ops Panel

Compute Clones: Turn on to clone the object chosen with the object to clone button.

Compute Positions/Rotations/Scales: Any options in this column that are turned on when you click the scatter button cause the respective transforms to be applied to the current selection (see select objects to transform, below) according to the settings in the position panel, rotation panel and scale panel.

Increment Seed Positions/Rotations/Scales: Any options in this column that are turned on cause the respective rand seed settings to be incremented by 1 each time you click the scatter button.

Select Objects To Transform: Letsyou designate objects to be affected by clicking the scatter button.

Scatter: Performs any cloning and/or transforms that are turned on.

OK: Retains all changes and closes the dialog.

Cancel: Forgets any changes and closes the dialog.

	Study Notes

	Assessment

Scatter object rollout of the Crowd helper object includes facilities for creating crowds by cloning objects.(True / False)

______________Forgets any changes and closes the dialog.

	Discussion

Use the following path and apply it. Select Crowd >Modify panel >Setup rollout >(Scatter)

9.10 Behaviour Assignments and Teams Dialog

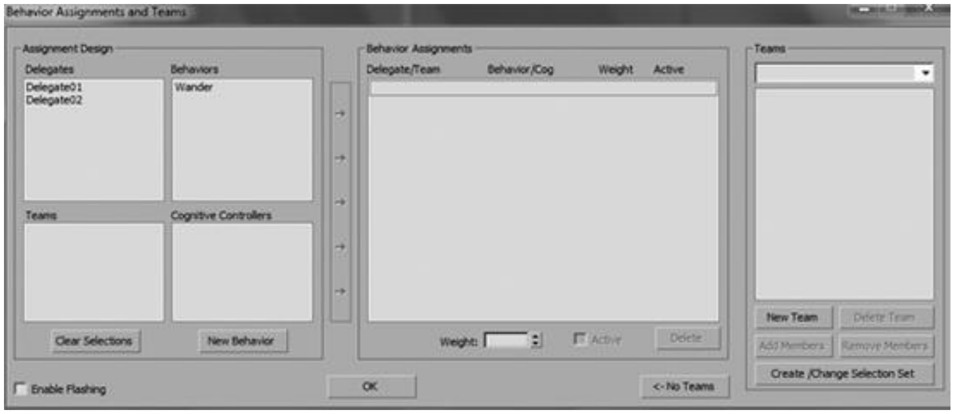

Fig. 9.12:Behaviour Assignments and Teams Dialog

The Behaviour Assignments and Teams dialog let you group delegates into teams and assign behaviours and cognitive controllers to individual delegates and teams. It also let you modify existing assignments.

The dialog is modeless; while it is open, you can use the Modify panel to adjust behaviours and set up new behaviours, as well as animate assignments' Weight settings.

- Click a delegate or team in the Assignment Design group
- Click an assignment in the Behaviour Assignments group
- Add members to a team in the Teams group
- Remove members from a team in the Teams group

9.10.1 Assignment Design Group

Let you set up assignments by choosing a behaviour or cognitive controller and a delegate or team to assign it to.

Delegates: Lists delegates in the scene.

Behaviours: Lists existing behaviours.

Teams: Lists teams in the scene.

Cognitive Controllers: Lists existing cognitive controllers.

Clear Selections: Deselects all highlighted items in the assignment design and behaviour assignments groups.

New Behaviour: Opens the select behaviour type dialog, which let you add a behaviour to the scene for use in an assignment.

New Assignment/Reset Assignment: Click to assign a behaviour or behaviours or a cognitive controller to a delegate or team.

This vertical button with five right-pointing arrows on it is situated between the Assignment Design and Behaviour Assignments group. It is available only when two items in the Assignment Design group are highlighted (exception: Multiple behaviours can be highlighted). If no item in the Behaviour Assignments group is highlighted, clicking the button creates a new assignment and adds it to the assignments list. If one or more items in the Behaviour Assignments group are highlighted, clicking the button sets the highlighted assignments to use the highlighted delegate/team and behaviour/cognitive controller combination.

9.10.2 Behaviour Assignments Group

List Box: Displays all current behaviour assignments, including team or delegate name, assigned behaviour or cognitive controller, weight setting and active status.

Weight: The relative effect of the assigned behaviour or cognitive controller.

Active: When on, the assignment is currently in effect. when this option is off, the assignment has no effect.

Delete: Deletes the highlighted behaviour assignment.

9.10.3 Teams Group

Drop-Down List: Displays the name of the current team.

List Box: Displays delegates in the current team.

New Team: Adds a team to the list and opens the select delegates dialog to let you specify new team members.

Delete Team: Deletes the current team.

Add Members: Letsyou add members to the current team.

Remove Members: Removes selected members from the team.

Create/Change Selection Set: Adds the current team to the list of selection sets, accessible from the named selection sets list on the main toolbar.

Enable Flashing: When on and you click a list item in the dialog or create/modify a team, the relevant objects highlight briefly in the view ports to indicate which are affected.

OK: Click this button to accept all changes and close the dialog.

No Teams/Teams: Toggles display of the teams group box.

	Study Notes

	Assessment

1. _________ deletes the current team.
2. Follow the path:

   Select Crowd >Modify panel >Setup rollout >

	Discussion

Follow the sequence :

1. In the Teams group, click On New Team button.
2. Use the Select Delegates dialog and then click OK button.
3. To change a team name, choose it from the drop-down list and then edit the text.
4. Choose the team from the drop-down list and then click on Remove Members button.
5. Click the Add Members button and then use the Select Delegates dialog

9.11 Cognitive Controll er Editor

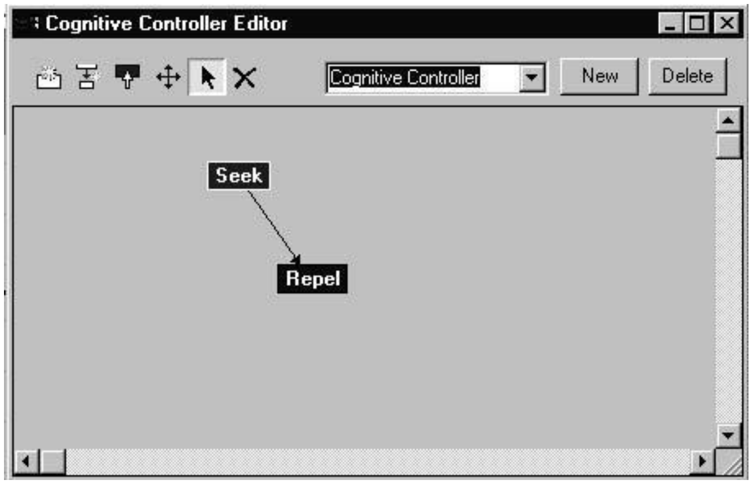

Fig. 9.13: Cognitive Controller Editor

The Cognitive Controller editor let you combine behaviours into states. More importantly, it let you sequence different behaviours and behaviour combi nations using state diagrams, where condition als written in MAXScript impose changes in behaviour. For example, you can specify that a character or object is to wander aimlessly u ntil it comes within a certain distance of another object, whereupon it heads straight fo r that object. Alternatively, you can specify that one character is to avoid another only when the second character is avoiding the first.

The editor interface cons ists of an icon-based toolbar above a window that contains the state diagram. When you first open the editor, no state diagrams exist. Be gin by clicking the ‘New’ button to create a new state diagram.

Create State: Letsyou create new states in the diagram.

Create Transition: Letsyou link states with transitions.

Set Start State: Normally the state that executes first in a cognitive co ntroller is the one that was added first.

Move State: Letsyou move states around in the window by dragging th em.

Select State/Transition: Letsyou select states and transitions for subsequent deletion. selected states have w hite outlines and selected transition lines are white.

Delete State/Transition: Lets you delete one or more states or transitio ns.

Name: Shows the name of the current state diagram. to display and/or edit another, choose it from the list.

New: Adds a new cognitive controller.

Delete: Deletes the current cognitive controller. This is an undoable operation.

9.11.1 STATE DIALOG

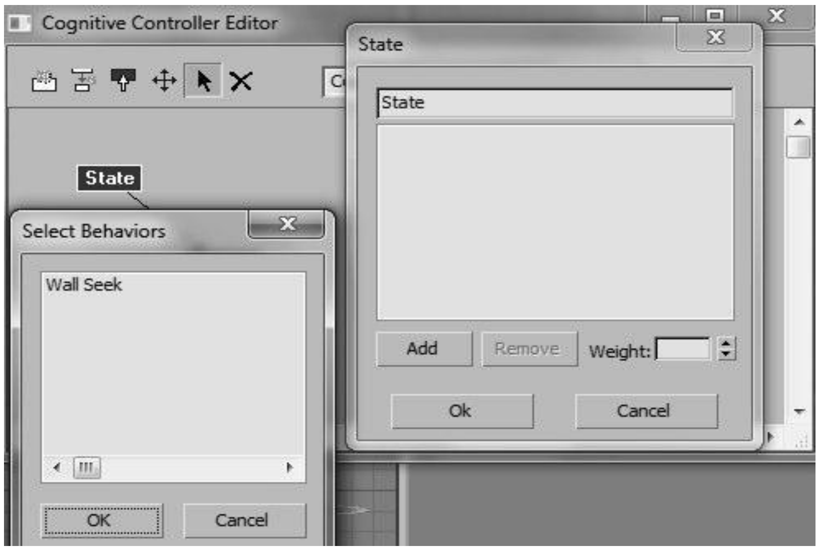

Fig.9.14: State Dialog and Select Behaviour in State Dialogue

State Name: Displays the name of the state.

List: Displays the names of all behaviours associated with the state.

Add: opens the select behaviour dialog, which displays the names of all behaviours in the current crowd object that are not associated with the current state.

Remove: Eliminates the highlighted behaviour from the state.

Weight: Specifies the selected behaviour's relative influence in the state.

OK: Closes the dialog and implements changes.

Cancel: Closes the dialog and ignores changes.

9.11.2 STATE TRANSITION DIALOG

These settings control how the software affects a transition from one state to another when using a cognitive controller. Right Click on a transition to open up the dialog

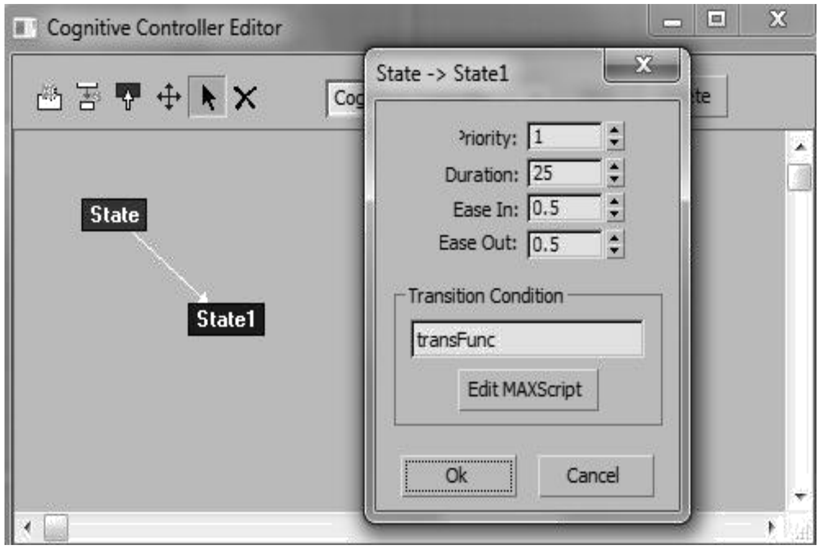

Fig. 9.15: State Transition Dialog

Priority: Sets the transition's precedence.

Duration: The number of frames the software takes to effect the transition between states.

Ease In: The rate at which the transition begins.

Ease Out: The rate at which the transition ends.

Transition Condition: The name of the maxscript function that specifies when/how the transition is to occur.

Edit Maxscript: Opens an editor window for editing, saving and loading the transition's maxscript script.

OK: Closes the dialog and implements changes.

Cancel: Closes the dialog and ignores changes.

	Study Notes

	Assessment

State true or false.

1. Ease In and Ease Out are respectively used for the rate at which the transition begins and transition ends.
2. Priority: Sets the transition's precedence.

	Discussion

Select Crowd>Modify panel >Setup rollout >Cognitive Controllers. Follow the path and use it.

9.12 Assigning Behaviours

In the real world, different crowds exhibit diverse behaviours and even members of the same crowd can conduct themselves in various ways. Included with the character studio, Crowd system is an assortment of behaviours that let you simulate a range of crowd activities.

Behaviours let you assign procedural activity types to delegates, which in turn affect objects linked to delegates. You can associate any number of behaviours with each crowd object and then link delegates and teams of delegates to each behaviour. A specific behaviour assigned to a Crowd object belongs only to that crowd; it cannot be assigned to any other crowds.

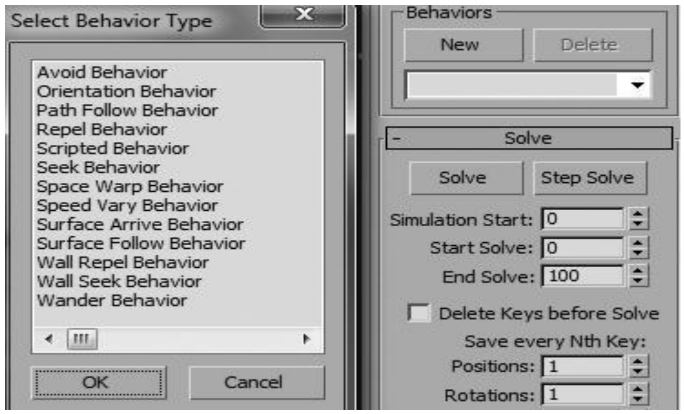

Fig. 9.14: List of Behaviour

Following is a list of available behaviours:

- Avoid Behaviour: Prevents delegates from colliding with objects in the scene or with each other. Avoidance can use any combination of turning, braking/stopping, repelling and vector field.
- Orientation Behaviour: Applies a fixed orientation or orientation range to delegates, so they face a specific direction instead of toward the destination. You can specify orientation in absolute terms or relative to the direction, the delegate currently faces.
- Path Follow Behaviour: Restricts motion to a spline or NURBS curve; options include back-and-forth patrol-type movement.
- Repel Behaviour: Forces delegates to move away from a target.
- Scripted Behaviour: Uses MAXScript to specify behaviour.
- Seek Behaviour: Moves delegates toward a target or targets.
- Space Warp Behaviour: Uses any dynamics-oriented space warp to control movement, including wind and gravity. Vector Field, a crowd-specific space warp that let delegates avoid irregularly shaped objects while following their contours, is included with character studio.
- Speed Vary Behaviour: Let delegates change speed for more realistic movement.

- Surface Arrive Behaviour: Let delegates move toward and land on a surface, with custom speed and acceleration parameters.

- Surface Follow Behaviour: Delegates move along a surface, which can be animated. Also, you can specify whether the delegates are to move straight ahead or skirt hills and depressions.

- Wall Repel Behaviour: Uses a grid to repel delegates; ideal for keeping objects inside an enclosed, straight-sided room.

- WallSeekBehaviour: Uses a grid to attract delegates. You can use this as a doorway for crowd-controlled bipeds to walk through.

- Wander Behaviour: Induces a realistic semi-random movement for characters such as shoppers at a mall.

The first time you add behaviour to the scene, a new rollout appears for the behaviour below the Setup rollout. This rollout let you change settings for the behaviour. Certain behaviours, such as Seek and Avoid, let you specify "target" objects.

To display the rollout for a different behaviour in the scene, choose it from the drop-down list in the Behaviours group. To see the controls available in the rollout for a behaviour type, follow the link from its entry in the above list.

In addition to the controls available in behaviour rollouts, you can use the Behaviour Assignments and Teams dialog to turn behaviours on and off (with the Active check box) and for all behaviours except Avoid, Orientation and Surface Follow, you can set and animate Weight. The Active status is animatable for all behaviours.

9.12.1Using Behaviours

To use a behaviour, you apply it to a delegate or a team of delegates using the Behaviour Assignments and Teams dialog. In this dialog, each assignment of a behaviour to a delegate is given a weight. You can modify and/or animate these weights to influence the simulation.

Behaviour assignment weights can profoundly effect a simulation. When applying two or more behaviours to the same delegate, the weights define the relationship between the behaviours, making one more or less powerful than the other. One way to visualise a behaviour assignment weight is to examine the behaviour's force vector during a crowd simulation. The vector's length indicates the behaviour's weight upon the delegate.

Each behaviour has its own parameters, which appear in the Behaviour rollout, available in the Crowd object's Modify panel. These parameters describe how the behaviour works and can sometimes contribute to the behaviour's strength as well. For instance, Seek, Repel, Wall Seek and Wall Repel, all have specific volumes of influence. Outside these volumes, they have no effect and essentially have a weight of zero. This rollout let you specify whether or not you wish to see behaviour's force vector dynamically displayed during a Crowd simulation and what colour that vector should be.

When working with the Crowd system, it is critical to play with behaviour assignment weights, as well as each behaviours' parameters. Typically, you run the simulation repeatedly, changing the weights and parameters to get the desired result.

A few behaviours cannot be weighted. These are Avoid, Surface Follow and Orientation. Avoid and Surface Follow takes over after all of the other behaviours have been applied to a delegate. They can take stringent measures to affect the delegate, possibly overpowering other behaviours in order to meet their constraints. Orientation simply sets the delegate's facing direction. It cannot be weighted and does not apply a force.

9.12.2 Avoid Behaviour

The Avoid behaviour let you specify any object or objects that delegates must keep away from. As delegates approach designated objects during the crowd simulation, they steer clear of them while turning and/or braking as necessary. This behaviour uses three different methods to let delegates avoid each other and other objects: Steer To Avoid, Repel and Vector Field.

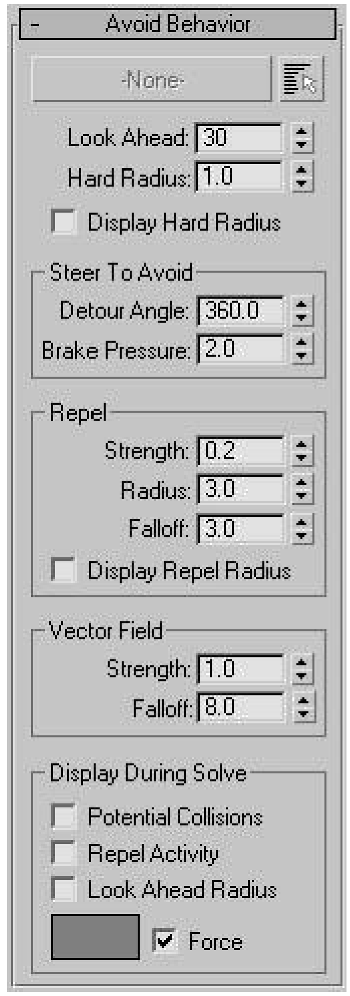

Fig. 9.14: Avoid Behaviour

Steer to Avoid behaviour is best used for animals that steer around each other at close proximity. Earthbound animals and fish typically do this. Steering motion may be sudden since its action is often engaged for relatively short periods.

By contrast, Repel avoidance behaviour mimics the continuous action of a repellent magnetic field. Birds, bats and flying insects are best animated with large Repel fields so that they can smoothly avoid each other while maintaining a comfortable margin of error. Repel forces prevent intrusion from all sides, regardless of the direction of travel. Thus, even animals that rely mainly on Steer to avoid will also need some degree of Repel avoidance to maintain spatial separation when they are moving through dense traffic. The forces of Repel avoidance are always directed uniformly outward in a spherical shape.

None (Label): specifies a single target. click this button and then click the target object in the viewport.

Multiple Selection: Opens the select dialog to let you designate multiple targets.

Look Ahead: The number of frames in advance of the current frame that the software looks for potential collisions.

Hard Radius: Distance from the target's pivot point, in multiples of the delegate's bounding sphere, where no penetration should occur.

Steer to Avoid Group

Steer to avoid is used by delegates to steer precisely around anticipated future collisions based on the delegates' current speed and direction. delegates using this approach can pass very close to one another.

Detour Angle: Maximum necessary turning angle relative to the direction of delegate's goal that delegate will steer to avoid rather than slow down and wait.

Brake Pressure: Determines how strongly a delegate will react when it encounters an avoided object.

Repel Group

Repel is a general separation force that is based only on the spatial position. Delegates use this to keep from getting into situations where they might side-swipe each other or where they might get so close that Steer To Avoid is too difficult to achieve.

Strength: Determines the strength of the repelling force; higher values result in greater repulsion force.

Radius: Maximum distance from delegate's bounding sphere within which "repel" avoidance is sensed and carried out.

Falloff: The rate at which the strength diminishes between the repel radius and the hard radius.

Display Repel Radius: Enables display of a wireframe sphere that depicts the extent of the repel setting.

Vector Field Group

If you have applied a Vector Field space warp to an object in your scene, you can specify the vector field as an object to avoid. The distinction is this: When used with the Space Warp behaviour, delegates use the vector field to steer around the object by being guided to travel perpendicular to the field's vectors. When used with the Avoid behaviour, the delegate simply moves away in the direction of the vectors.

Potential Collisions: Displays a green line from the delegate to the location of a potential collision.

Repel Activity: Displays a white line between the delegate and target when the repel force is in effect.

Look Ahead Radius: Displays a sphere that shows the current distance used to check for potential collisions.

Colour Swatch: Shows the colour used to draw the avoid force vector during the solution. click the box to choose a different colour.

Force: When on, force exerted on one or more delegates by the avoid behaviour is drawn in the viewports as a coloured line during the simulation solution.

9.12.3 Orientation Behaviour

Heading Group

Fig. 9.15: Orientation Behaviour Options

Use these controls to affect how delegates turn on the vertical axis. By default, heading is absolute, with 0 specifying the positive X axis in World coordinates. Thus, -90 would specify the negative Y-axis, 90 the positive Y axis and 180 or -180 the negative X axis.

Absolute Heading As Viewed From The Top

You can also specify heading limits in amounts relative to the delegate's heading at the time that the Orientation behaviour takes effect by turning on the Relative check box.

Relative: When on, heading settings are applied relative to the delegate's heading at the time the behaviour takes effect. if this option is off, settings are absolute.

Min Heading: The minimum permissible heading. this number should be lower than the max heading value.

Max Heading: The maximum permissible heading. this number should be higher than the min heading value.

Max Heading Velocity: Specifies how much the delegate's heading can change per frame.

Head Response: Determines how quickly the heading follows the direction the object is moving in.

Pitch Group

Use these controls to affect how delegates turn on the left-right axis.

Relative: When on, pitch settings are applied relative to the delegate's pitch at the time the behaviour takes effect.

Min Pitch: The minimum number of degrees a delegate can incline or decline.

Max Pitch: The maximum number of degrees a delegate can incline or decline.

Max Pitch Velocity: Specifies how much the delegate's pitch can change per frame.

Pitch Response: Determines how quickly the pitch follows the direction the object is moving in, direction the delegate is moving (within the limits) while a lower value means that it is less responsive.

Max Bank: The maximum number of degrees the delegate can bank.

Max Bank Velocity: The maximum number of degrees the delegate's bank angle can change per frame. This Controls Angular Acceleration And Deceleration.

Bank Per Turn: The number of degrees the delegate will bank as a function of the turn angle at the current frame.

None (Label): Click this button, then select a path object. Suitable path objects include splines and nurbs curves. If a path object contains more than one spline or curve, character studio uses the lowest-numbered element (usually the earliest created one).

Radius: The radial distance from the path, in units, within which the delegate stays while traversing the path.

Turning Group

These parameters determine how delegates turn while following the path. Awareness determines how well a delegate anticipates turns in the path as it moves; you can apply random variation to Awareness with the Deviation setting.

Awareness:Specifies how "intelligent" the delegate is while traversing this path. a high awareness setting means that it takes into account the curve of the path while moving and will try to anticipate changes. a low value for awareness, on the other hand, means that the delegate notices the path only when leaving it.

Fig. 9.16: Path Follow Behaviour Rollout

Deviation:Specifies the maximum amount by which awareness should vary. Characterstudio takes a random number between the negative and positive values of the deviation setting, multiplies it by the awareness setting and adds the result to awareness.

Starting Point

Determines where on the path the delegate begins to follow the path. The default choice is Beginning of Path.

Beginning Of Path:The delegate first moves to the start of the path before following it.

End Of Path:The delegate first moves to the end of the path before following it. With closed curves, this is the same point as the beginning of the path.

Nearest Point:The delegate first moves to the closest point on the path and then follows the path from there.

Direction

Determines the direction the delegate takes initially when following the path. The default choice is Forwards.

Forwards:The delegate moves along path vertices in ascending order.

Backwards: The delegate moves along path vertices in descending order.

Action At End Of Path

Determines what the delegate does when it reaches the path end. The default choice is Loop.

Loop: The delegate loops around the path, even if it is not closed. If beginning of path or end of path is chosen, it returns to the path's start or end point, each time it finishes traversing the path.

Reverse: The delegate reverses direction at the end of the path. Use This Choice To Simulate A Back-And-Forth "Patrol" Behaviour.

Continue: The delegate continues moving in the same direction it faced at the end of the path until the simulation ends or it is acted upon by another force or behaviour.

Seed: Specifies a seed value for randomizing awareness.

Colour Swatch: Shows the colour used to draw the path follow force vector during the solution. click the box to choose a different colour.

Display Force: When on, force exerted on the delegate by the path follow behaviour is drawn in the view ports as a vector during the simulation solution.

Colour Swatch: Shows the colour used to draw the target icon.

Display Target: Enables display of the target icon, which appears during the solution when a new interim goal is calculated for the delegate.

Target Scale: Specifies the overall size of the target icon.

9.12.5Repel Behaviour

None (Label): Specifies a single source. Click this button and then click the target object in the viewport.The target name then appears on the button.

If you have selected multiple sources using Multiple Selection (see next item), the word Multiple appears on the button. To see which objects are designated as sources, click the Multiple Selection button.

Multiple Selection: Opens the select dialog to let you designate multiple sources. When you have more than one source, you can set delegates to move toward the closest target in the group or to a computed average of the source positions.

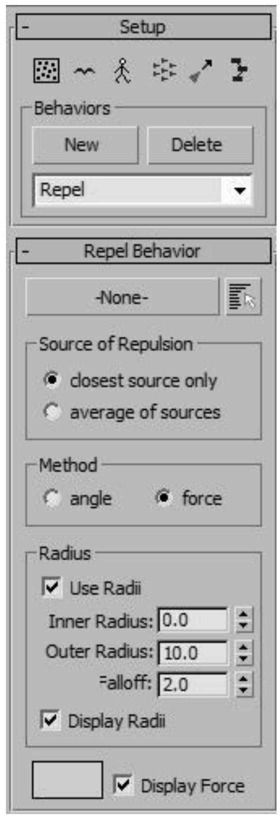

Fig.9.17: Repel Behaviour Rollout

Source Of Repulsion Group

Determines repel activity when the behaviour uses multiple sources. The default choice is Closest Source Only.

Closest Source Only: Each delegate is repelled by the closest of the assigned sources.

Average Of Sources: All delegates move away from a common point determined by averaging all sources' locations.

Method Group

This determines whether delegate direction as influenced by the behaviour is calculated by an angular method or a force method. Default is Force.

Angle: Applies a force to the delegate based on the angle between the delegate's current direction and the direction it would need to take in order to be moving directly away from the source.

Force: Always applies a force directly away from the source. the magnitude of the force is constant.

Radius Group

Use the Radius settings to activate the Repel behaviour only when the delegates are within a specific distance from the target. The relative strength of the force increases from 0 percent at the outer radius to 100 percent at the inner radius.

Use Radii: When on, the behaviour applies only to delegates closer to the target than the outer distance value.

Inner Radius: The distance from the target at which the force is applied at full strength.

Outer Radius:The distance from the target at which the force begins to be applied.

Display Radii: The radii are displayed when the force is active.

Colour Swatch: Shows the colour used to draw the repel force vector during the solution. click the box to choose a different colour.

Display Force: When on, force exerted on the delegates by the repel behaviour is drawn in the view ports as a vector during the simulation solution.

9.12.6 Scripted Behaviour

Behaviour Type: Choose Force, Constraint or Orientation.

Script Context Name: Specify a name for the script.

Edit Maxscript: Click to open an editor window.

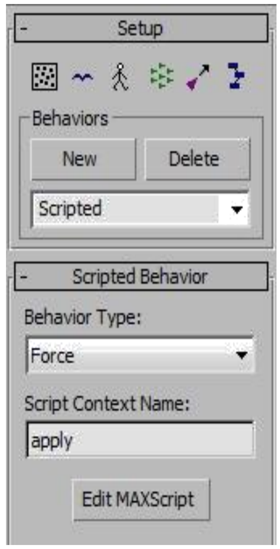

Fig. 9.18: Script Behaviour Rollout

9.12.7 Seek Behaviour

None: Specifies a single target. Click this button and then click the target object in the viewport.

Multiple Selection: Opens the select dialog to let you designate multiple targets. When you have more than one target, you can set delegates to move toward the closest target in the group or to a computed average of the target positions.

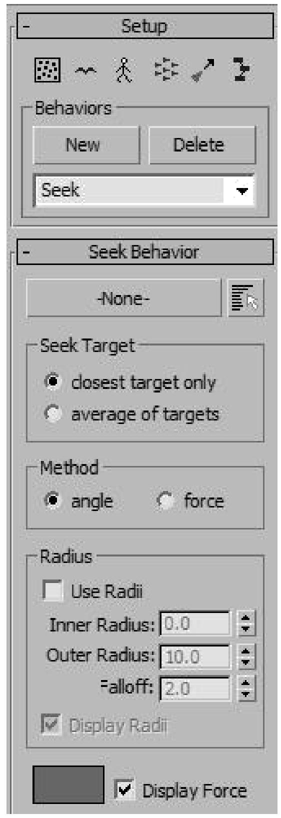

Fig. 9.19: Seek Behaviour Rollout

Seek Target Group

Closest Target Only: Each delegate seeks the closest of the assigned targets. Use this to have delegates assigned a single seek behaviour move in different directions.

Average Of Targets: All delegates move toward a common point determined by averaging all targets' locations.

Method Group

Angle: Applies a force to the delegate based on the angle between the delegate's current direction and the direction it would need to take in order to be moving directly toward the target.

Force: Always applies a force directly towards the target. the magnitude of the force is constant.

Radius Group

Use Radii: When on, the seek behaviour applies only to delegates less than the outer radius distance from the target.

- Inner Radius: The distance from the target at which Seek is applied at full strength
- Outer Radius: The distance from the target at which Seek begins to be applied
- Display Radii: The radii are displayed when the force is active.

Colour Swatch: Shows the colour used to draw the seek force vector during the solution. click the box to choose a different colour.

Display Force: When on, force exerted on the delegates by the seek behaviour is drawn in the viewports as a vector during the simulation solution.

9.12.8 Speed Vary Behaviour

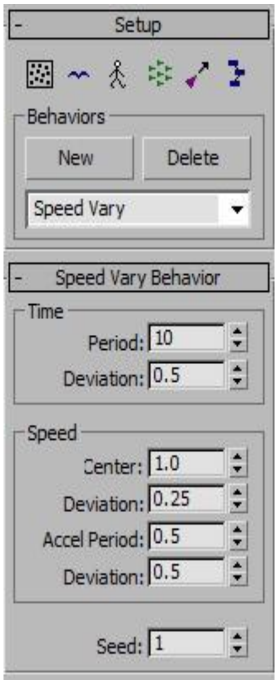

Fig. 9.20: Speed Vary Behaviour Rollout

Period: Specifies how many frames should elapse before a new speed is chosen.

Deviation: Specifies the maximum amount by which period should vary.

Speed Group

Center: Specifies the speed the delegate should change to center is a multiplier

Deviation: Specifies the maximum amount by which the delegate's calculated speed

Accel Period: Specifies the rate at which the delegate's speed should change in relation to the period length.

Deviation: Specifies the maximum amount by which acceleration should vary.

Seed: Specifies avalue for randomizing the speed vary behaviour.

9.12.9 Surface Arrive Behaviour

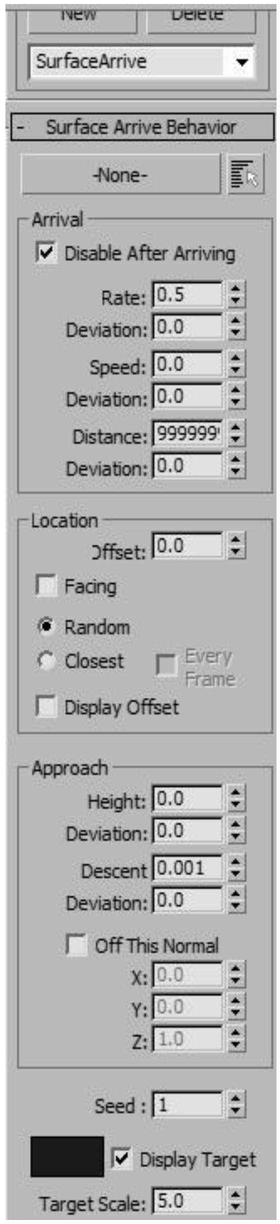

Fig.9.21: Surface Arrive Behaviour Rollout

None: Specifies a single target.

Multiple Selection: Opens the select dialog to let you designate multiple targets.

Disable After Arriving: When on, turns off the surface arrive behaviour after the delegate arrives at the surface.

Rate: A multiple of the delegate's max accel setting that specifies the acceleration with which it will try to arrive.

Deviation: Adds random variation to the rate setting.

Speed: The speed at which to arrive, relative to the speed of the target.

Deviation: Adds random variation to the speed setting.

Distance: The maximum radial distance from the target within which the behaviour will be active.

Deviation: Adds random variation to the distance setting.

Location Group

Offset: Specifies a consistent distance from the calculated arrival point, based on the surface normal, for the delegate to use.

Facing: When on, the delegate will try to arrive only at points on triangles on the surface that are facing it.

Random: The software chooses a random point on the target surface as the arrival point.

Closest: The software chooses the closest point on the target surface as the arrival point.

Every Frame: When on, the software chooses arrival points for delegates at every frame.

Display Offset: When on, shows the offset distance as lines emanating from each vertex in the surface object, perpendicular to the surface.

Height: Specifies a distance from the arrival point along its face normal.

This is the point that the delegate will go to first before descending to the arrival point.

Deviation: Adds random variation to the height setting.

Descent Start: Specifies the distance between the delegate and the arrival point at which the descent should start.

Deviation: Adds random variation to the descent start setting.

Off This Normal: When on, let you set an approach vector to specify the angle at which the final approach occurs.

X/Y/Z: Use these settings to specify the final approach vector in world coordinates.

Seed: Affects the random numbers used to calculate the deviation settings.

Colour Swatch: shows the colour used to draw the target icon.

Display Target: Enables display of the target icon, which appears during the solution when a new interim goal is calculated for the delegate.

Target Scale: Specifies the overall size of the target icon.

9.12.10 Surface Follow Behaviour

Fig. 9.22: Surface Follow Behaviour Rollout

None: Specifies a single "target" object to use as a surface. click this button and then click the target object in the viewport. The target name then appears on the button.

Multiple Selection: Opens the select dialog to let you designate multiple targets.

Use Projection: When on, surface follow calculates delegate direction from the specified vector, rather than using the default.

X/Y/Z: Specifies a vector-using world coordinates.

Offset: Specifies the delegate's distance above the surface, using the surface normal.
it is recalculated at each frame.

Display Offset: When on, shows the offset distance as lines emanating from each vertex in the surface object, perpendicular to the surface.

Colour Swatch: Shows The colour used to draw the surface follow target during the solution. Click the box to choose a different colour.

Display Target: When on, the interim goal for each delegate influenced by the surface follow behaviour is drawn in the viewports as a wireframe sphere during the simulation solution.

Target Scale: Sets the target size.

9.12.11 WALL REPEL BEHAVIOUR

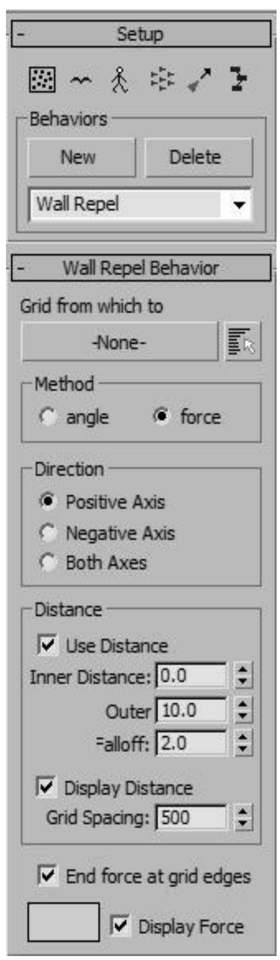

Fig. 9.23: Wall Repel Behaviour Rollout

Grid From Which To Repel: Set a repelling grid ("source") by clicking the none button and then selecting the grid. Thereafter, the grid's name appears on the button.

Angle: Applies a force to the delegate based on the angle between the delegate's current direction and the direction it would need to take in order to be moving directly away from the source.

Force: Always applies a force directly away from the source. the magnitude of the force is constant.

Positive Axis: The grid repels only from the positive-axis side.

Negative Axis: The grid repels only from the negative-axis side.

Both Axes: The grid repels from both sides.

Use Distance: When on, the behaviour applies only to delegates closer to the target than the outer distance value.

Inner Distance: The distance from the target at which the force is applied at full strength.

Outer Distance: The distance from the target at which the force begins to be applied.

Falloff: The rate at which the repelling force diminishes between the inner distance and the outer distance.

Display Distance: Shows the inner and outer distance settings as grids offset from the target grid in the viewports.

Grid Spacing: Alters the spacing of grid lines used to draw the inner/outer distance grids.

End Force At Grid Edges: When on, the force emanates only from the grid object.

Colour Swatch: Shows the colour used to draw the wall repel force during the solution. click the box to choose a different colour. default=violet.

Display Force: The force, when activated, is drawn in the view ports as a wire frame rectangle during the simulation solution.

Study Notes

Assessment

1. In Wall repel rollout >direction there are three options. List them.
2. Positive Axis- grid repels only from the positive-axis side. (True / False)

Discussion

Follow the path and apply it on the biped. Select Crowd >Modify panel >Setup rollout >Behaviours group >Choose wall repel from the drop-down list.

9.13 Delegates

In crowd animation, the Delegate helper serves as an agent for the motion created by a Crowd object and its behaviours. The Crowd object controls a delegate or delegates, whose motion can then be imparted to a biped or other object.

In view ports, the delegate object takes the shape of a pyramid. By default, the point of the pyramid indicates the delegate's forward direction. Delegates cannot be rendered.

Study Notes

Assessment

State true/ false

1. Delegate serves as an agent for creating motion.
2. The Crowd object controls a delegate.

Discussion

Follow the path and apply it on the biped. Create panel >Helpers>Object Type rollout >Delegate

9.14 Non-Biped Crowds

Motion synthesis in character studio let you the software derive character motion from a combination of crowd behaviours and either motion flow networks, when animating bipeds or clip controllers, when working with non-bipedal creatures. In the later case, using the Global Motion Clip and Master Motion Clip controllers, you can animate groups of creatures such as birds, butterflies, schools of fish and insects. Either you can create clip controllers as block controllers in Track View, or, more directly, with the Crowd helper controls on the Global Clip Controllers rollout.

	Study Notes

	Assessment

1. State true/ false

   a. Either you can create clip controllers as block controllers in Track View or more directly, with the Crowd helper controls on the Global Clip Controllers rollout.

   b. Motion synthesis in character studio let the software derive character motion from a combination of crowd behaviours and either motion flow networks, when animating bipeds or clip controllers, when working with bipedal creatures.

2. Using the Global Motion Clip and Master Motion Clip controllers, which are the examples?

	Discussion

Work with a non-bipedal creature.

9.15 Two Approaches to Animation

You can animate your creature either in place with looping animation but no transformational motion (such as a bird flapping its wings) or you can incorporate transformational motion into the animation as well (the bird moves upward while flapping its wings). In-place cyclic motion lends itself to flying or swimming motions like birds and fish, while adding lateral motion lends itself to crawling type animation where feet should be planted on the ground and not sliding. Depending on which you use, you can toggle options on the Motion Clips tab of the Synthesis dialog. In both cases, you use crowd delegates driven by behaviours to motivate the creatures, which are linked to those delegates.

9.15.1 Cyclic In-Place Animation

First, you create a creature with a few short loop cycles, like the beating of wings, gliding, turning left and turning right. This creature is assigned as the Global Object or the master object from which the motion clips will be derived. Then clones of the original creature are created. The clones are positioned and linked to delegates. States are created to select which clips will play based on a state.

9.15.2 Animation with Lateral Motion

For multi-legged creatures that walk, you can animate lateral motion as well as the cyclic motion of the legs moving. This is done to ensure that the creatures' feet do not slide as they move. The software then uses the lateral motion information to create a state that perfectly matches the actual motion. The software then strips the actual motion out. When a delegate approaches the speed and heading recorded in that state, the appropriate motion clip is triggered. This technique minimises sliding feet.

Use the character studio crowd tools to create the initial motion for the delegates. For example, use a seek or avoid behaviour to steer birds. Your object with the loop animation is then copied and the copies are linked to the delegates to create the complete animation. The delegate handles the path and the clip controllers handle the looped animation.

You can create Master Motion Clip and Global Motion Clip in Track View by assigning a controller to the available controller under Block Control. It is, however, simpler to use the Crowd helper controls on the Global Clip Controller rollout to apply and use the clip controllers.

Scaling A Character

Using standard 3ds max scale transform tools, you can adjust a biped's posture by scaling the size of its links. You must be in Figure mode to scale the biped links. If you try to scale a biped without going into Figure mode, nothing happens.

Customising Transitions

A good transition links two clips together seamlessly; the motion through the transition should appear natural, as though the motion was captured as one long motion sequence. If clips do not transition smoothly, you may find it necessary to edit or customise your transitions. There are two ways to manually edit transitions.

- In the Motion Flow Graph, you can right click a transition arrow.
- If you have defined a script, highlight a clip and click the Edit Transition button.

Transitions can be edited automatically by using the Optimize Transition features. When you create a script, default transitions are set between the clips. Default transitions use minimum motion loss and are quick to compute. However, the best quality transitions are the optimized transitions. Optimized transitions use a minimum foot-sliding algorithm to compute the transition and yield very good results.

Study Notes

	Assessment

1. A bird flapping its wings is the appropriate example for which approach(es) of animation?
2. State true/ false

   A good transition links two clips together seamlessly; the motion through the transition should appear natural, as though the motion was captured as one long motion sequence.

	Discussion

Create the animation of bird wings.

9.16 Summary

GEOMETRY PARAMETERS ROLLOUT

Width, Depth, Height: Sets the width, depth and height of the delegate object. These fields also act as readouts when you create the delegate.

MOTION PARAMETERS ROLLOUT

The motion parameters rollout lets you specify a delegate object's characteristics, including speed, acceleration and other factors. it also let you associate the delegate with a biped.

PRIORITY ROLLOUT

The Crowd system uses the Priority rollout settings when solving a simulation involving bipeds associated with delegates. The Priority parameter is a positive integer assigned by the user to a delegate. When priorities are used, the Crowd simulation computes one biped at a time, based on its priority setting from lowest to highest; that is, a lower Priority setting means a higher priority.

Edit Multiple Delegates Dialog

The Edit Multiple Delegates dialog let you define groups of delegates and set parameters for them. You can create and store up to 10 different configurations or settings combinations; each consists of one or more delegates and settings for the delegates.

Space Warp Behaviour The Space Warp Behaviour Let Space Warps, Such As Wind Or Gravity, Influence A Crowd Simulation. You Can Use It To Apply Space Warps In The Forces And Particles &Dynamics Categories To Crowd Members.

Wander Behaviour

The Wander behaviour imparts a random motion to delegates, letting you simulate meandering activity in which delegates move and turn in a haphazard manner. It works by randomly picking a new direction and then turning and moving in that direction.

Scatter objects dialog

The Scatter Objects dialog of the Crowd helper object includes facilities for creating crowds by cloning objects, such as delegates. It also let you distribute the clones and other objects within a radial area, along a shape, across a grid object or surface or within a box or sphere.

Behaviour Assignments and Teams Dialog

The Behaviour Assignments and Teams dialog let you group delegates into teams and assign behaviours and cognitive controllers to individual delegates and teams. It also let you modify existing assignments. The dialog is modeless; while it's open, you can use the Modify panel to adjust behaviours and set up new behaviours, as well as animate assignments' Weight settings.

Cognitive controller editor

The Cognitive Controller editor let you combine behaviours into states. More importantly, it let you sequence different behaviours and behaviour combinations using state diagrams, where conditionals written in MAXScript impose changes in behaviour.

Assigning behaviours

Behaviours let you assign procedural activity types to delegates, which in turn affect objects linked to delegates. You can associate any number of behaviours with each crowd object and then link delegates and teams of delegates to each behaviour.

Behaviour assignment weights can profoundly effect a simulation. When applying two or more behaviours to the same delegate, the weights define the relationship between the behaviours, making one more or less powerful than the other. One way to visualise a behaviour assignment weight is to examine the behaviour's force vector during a crowd simulation.

AVOID BEHAVIOUR

The Avoid behaviour let you specify any object or objects that delegates must keep away from. As delegates approach designated objects during the crowd simulation, they steer clear of them while turning and/or braking as necessary.

PATH FOLLOW BEHAVIOUR

The Path Follow behaviour let you animate the delegate(s) along a path.

Two approaches to animation

You can animate your creature either in place with looping animation but no transformational motion (such as a bird flapping its wings) or you can incorporate transformational motion into the animation as well (the bird moves upward while flapping its wings). In-place cyclic motion lends itself to flying or swimming motions like birds and fish, while adding lateral motion lends itself to crawling type animation where feet should be planted on the ground and not sliding.

Depending on which you use, you toggle options on the Motion Clips tab of the Synthesis dialog.First you create a creature with a few short loop cycles, like the beating of wings, gliding, turning left and turning right. This creature is assigned as the Global Object or the master object from which the motion clips will be derived. Then clones of the original creature are created. The clones are positioned and linked to delegates. States are created to select which clips will play based on a state.

For multi-legged creatures that walk, you can animate lateral motion as well as the cyclic motion of the legs moving. This is done to ensure that the creatures' feet do not slide as they move. The software then uses the lateral motion information to create a state that perfectly matches the actual motion. The software then strips the actual motion out. When a delegate approaches the speed and heading recorded in that state, the appropriate motion clip is triggered.

9.17 Self-Assessment Test

Broad Questions

1. What is Crowd System?
2. What are the different behaviours, which you can assign to the delegates in the crowd?
3. What are the two ways of animating a character?

    a. Crowd system
    b. Wander Behaviour
    c. Path Follow Behaviour
    d. Repel Behaviour
    e. Seek Behaviour
    f. Wall Repel Behaviour
    g. Delegates

9.18 Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Create Crowd or heard simulation using crowd system and delegation.

Unit 4 Motion Synthesis

Learning Outcome

After going through this unit, you will be able to:

- Show how to do motion synthesis
- Combine different motion clips to generate customised animation.
- Assign synthesized animation to multiple bipeds
- Vary the synthesized animation for multiple bipeds
- Display different panels used in motion synthesis
- Explain the state panel

Time Required to Complete the unit

The time required to study this Unit is broken as follows

1. 1st Reading: It will need 2 Hrs for reading
2. 2nd Reading with understanding: It will need 4 Hrs for reading and understanding
3. Self-assessment: It will need 2 Hrs for reading and understanding
4. Assignment: It will need 2 Hrs for completing an assignment
5. Revision and Further Reading: It is a continuous process

Content Map

10.1 Introduction to Motion Synthesis

10.2 Motion Clips Panel

10.3 Clip State Dialog

10.3.1 Speed Panel

10.1 Introduction to Motion Synthesis

Motion Synthesis is used to create customised (by combining different) motions for bipedal as well as non-bipedal crowd. The Motion Synthesis dialog is where you set up motion synthesis for non-bipedal crowd members. It uses three panels to split up the workflow. On the Motion Clips panel, you specify the global object from which the motion clips are to be derived; you also set up the motion clips here. Controls on the State panel let you set up states and link clips to states. The Motion Synthesis panel controls let you blend clips and synthesize the motion for some or all crowd members.

10.2 Motion Clips Panel

On the Motion Clips panel, you specify the global object from which the motion clips are to be derived. You also set up the motion clips here.

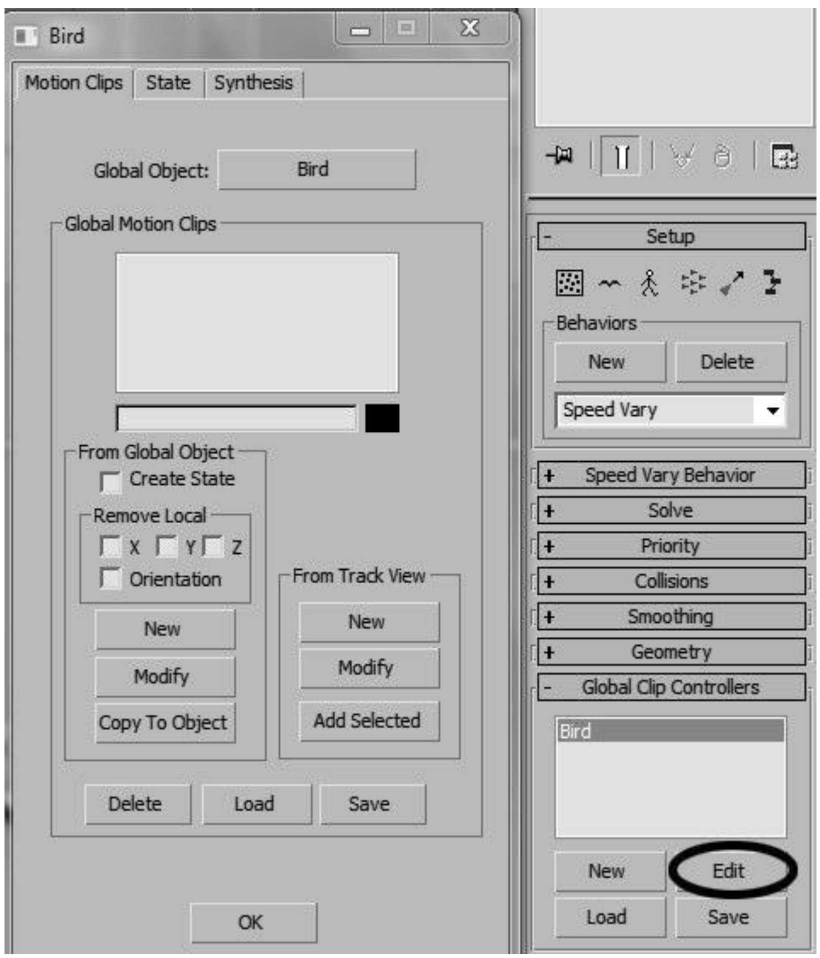

Fig. 10.1: Motion Clips Panel

Global Object: Click global object and pick the object that contains the animation (all the clips) in the select global objects to copy dialog.

List Window: The List Of Motion Clips. The Clips That You Create Appear In This List.

Edit Window: Rename or change the colour for the selected motion clip.

Create State: Create a new state with parameters specific to the motion clip, such as speed, heading, acceleration and so on.

Character studio evaluates the motion and orientation of the object and creates a new state with parameters set accordingly.

Remove Local X, Y, Z, Orientation: Turn on any or all of these options to strip out transformation and orientation data from the motion clip.

New: Letsyou set up a new motion clip.

Modify: Letsyou modify a motion clip's parameters. highlight the clip to modify and then click modify.

Copy To Object: The keys from the highlighted motion clip are copied back to the global object.

New: Letsyou create a motion clip from an animation track in track view.

Modify: Letsyou modify a motion clip in the list by changing the track view track from which it is derived, as well as the name and duration.

Add Selected: Creates a motion clip from only the selected tracks in track view.

Delete: Deletes the highlighted clip in the list.

Load: Loads a motion clip file (.clp). displays the load motion clip dialog. use the save command to create a .clp file.

Save: Saves a motion clip into a .clp file. Displays the save motion clip dialog.

OK: Accepts changes and closes the dialog.

	Study Notes

	Assessment
List Window is the list of motion clips. (True / False) From which option can you set up a new motion clip?	

	Discussion
Explain Motion clip panel from the above path.	

10.3 ClipState Dialog

In character studio, in crowd animation with non-bipedal motion synthesis, a state is a particular property or set of properties of a delegate's animation; for example, the period during which it is pitched upwards and is decelerating. After determining the delegate's state, the motion synthesis engine chooses a motion clip for animating the object or character, linked to the delegate; for example, a bird. When preparing a simulation that uses motion synthesis, you can use the Clip State dialog to define states and associate states with motion clips.

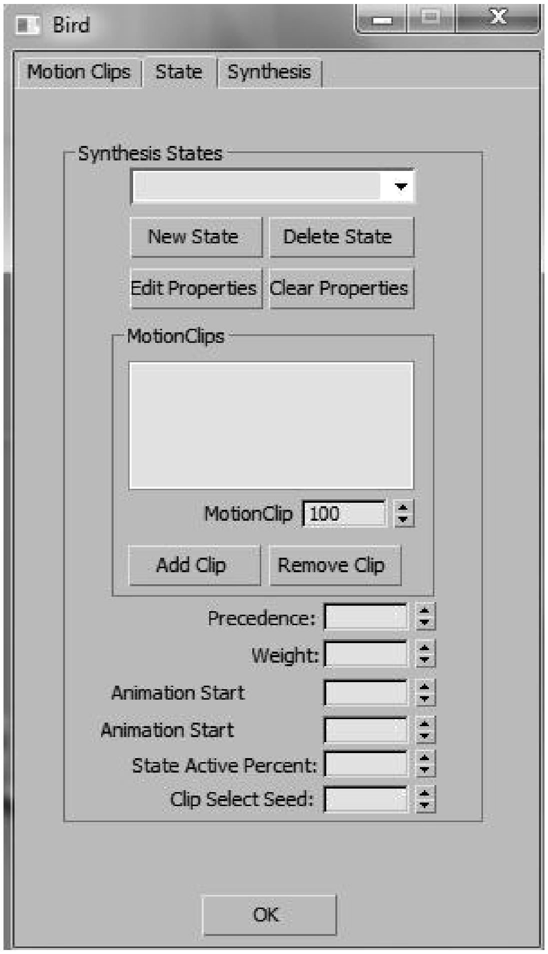

Fig. 10.2: Clip State Panel

You can define a state with any combination of these properties: speed, acceleration, pitch, pitch velocity and heading velocity (plus a script). For each active property, you can specify a range or a unique value that triggers the clip for its respective state.

When you use a range, be sure to set the Min setting lower than the Max setting. For example, when using a negative range such as -180 to -10, enter the number with the larger absolute value (-180) as the Min setting.

You can see the delegates' actual ranges and average values for all properties after synthesizing the clips.

The dialog panels are:

- Speed Panel
- Acceleration Panel

- Pitch Panel
- Pitch Velocity Panel
- Heading Velocity Panel
- Script Panel

10.3.1 Speed Panel

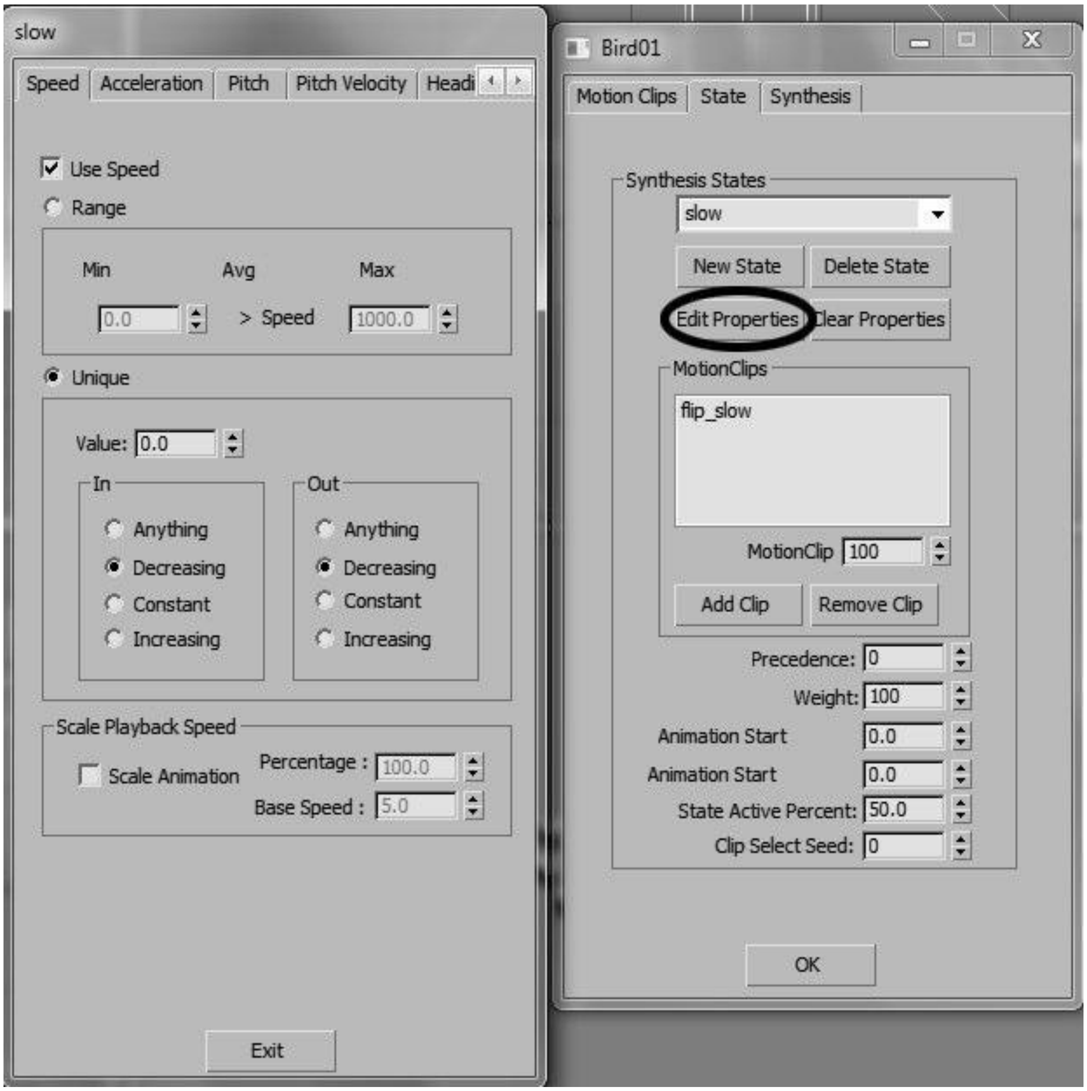

Fig. 10.3: Speed Panel

To have delegate speed considered for motion synthesis, turn on Use Speed, choose Range or Unique and then make the appropriate settings.

Speed is measured in units per animation frame, where the unit is the current 3ds max system unit. By default, this is Generic Units.

Use Speed: Turn on to have the motion synthesis engine, consider delegate velocity in determining whether to use the clip.

Range: Choose range to have the motion synthesis engine, activate the clip when the delegate's speed falls inside the specified range.

Range Display: After you synthesize the master motion clips, displays delegates' minimum, average and maximum speed.

Min: Set the minimum speed value for the range.

Max: Set the maximum speed value for the range.

Unique: Choose unique to have the motion synthesis engine activate the clip when the delegate's speed matches a specific value, optionally with a rising, falling or constant value before or after the specified value.

Value: Set a unique speed value.

In/Out: These radio buttons let you specify the behaviour of the parameter before and after the unique value is met.

- Anything: Speed before or after the target value is not relevant.
- Decreasing: Speed decreases before or after it reaches the target value.
- Constant: Speed before or after the target value is constant.
- Increasing: Speed increases before or after it reaches the target value.

Scale Animation: Scales the clip's animation based on speed.

Percentage: Specify how much to alter the playback speed based upon the difference between the delegate's speed and the base speed setting.

Base Speed: Specifies the delegate speed at which the animation should be played back at its normal rate.

10.3.2 Acceleration Panel

To have delegate acceleration considered for motion synthesis, turn on Use Acceleration, choose Range or Unique and then make the appropriate settings.

Use Acceleration: Turn on to have the motion synthesis engine consider delegate acceleration in determining whether to activate the state.

Range: Choose range to have the motion synthesis engine activate the clip when the delegate's acceleration falls inside the specified range.

Range Display: After you synthesize the master motion clips, displays delegates' minimum, average and maximum acceleration.

Min: Set a minimum acceleration value for the range.

Max: Set a maximum acceleration value for the range.

Unique: Choose unique to have the motion synthesis engine activate the clip when the delegate's acceleration matches a specific value, optionally with a rising, falling or constant value before or after the specified value.

Value: Set a unique acceleration value.

In/Out: These radio buttons let you specify the behaviour of the parameter before and after the unique value is met.

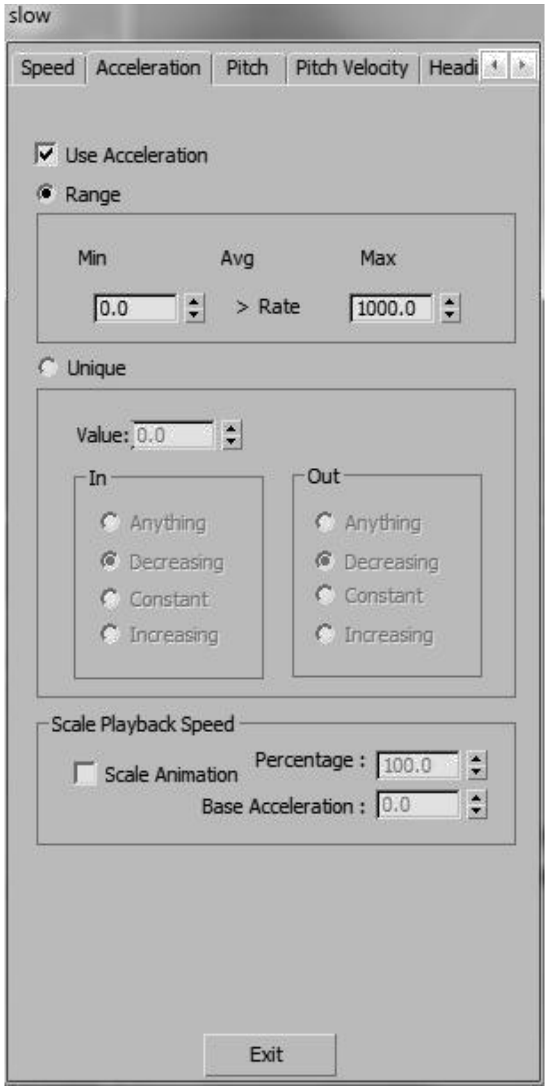

Fig. 10.4: Acceleration Panel

- Anything: Acceleration before or after the target value is not relevant.
- Decreasing: Acceleration decreases before or after it reaches the target value.
- Constant: Acceleration before or after the target value is constant.
- Increasing: Acceleration increases before or after it reaches the target value. Scale

Animation: Scale the clip's animation based on acceleration.

Percentage: Specify how much to alter the playback speed based upon the difference between the delegate's acceleration and the base acceleration setting.

Base Acceleration: Specifies the delegate acceleration at which the animation should be played back at its normal rate.

10.3.3Pitch Panel

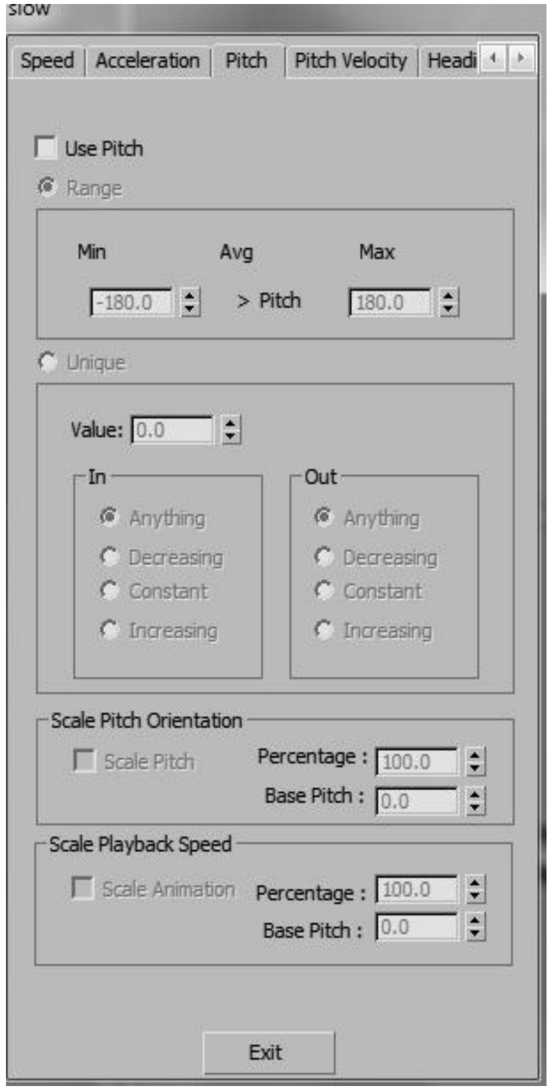

Fig. 10.5: Pitch Panel

To have delegate pitch considered for motion synthesis, turn on Use Pitch, choose Range or Unique and then make the appropriate settings.

Pitch is determined by the angle in degrees of the delegate about the world X-axis. In world coordinates, the delegate's pitch is positive when it is aimed upward, negative when it's aimed downward and 0 when it's aimed parallel to the home grid.

Use Pitch: Turn on to have the motion synthesis engine consider delegate pitch in determining whether to activate the state.

Range: Choose range to have the motion synthesis engine activate the clip when the delegate's pitch falls inside the specified range.

Range Display: After you synthesize the master motion clips, displays delegates' minimum, average and maximum pitch.

Min: Set a minimum pitch for the range.

Max: Set a maximum pitch for the range.

Unique: Choose unique to have the motion synthesis engine activate the clip when the delegate's pitch matches a specific value, optionally with a rising, falling or constant value before or after the specified value.

Value: Set a unique pitch value

In/Out: These radio buttons let you specify the behaviour of the parameter before and after the unique value is met.

- Anything: Pitch before or after the target value is not relevant.
- Decreasing: Pitch decreases before or after it reaches the target value.
- Constant: Pitch before or after the target value is constant.
- Increasing: Pitch increases before or after it reaches the target value. Scale Pitch

Orientation: Scales the clip's pitch based on delegate pitch.

Percentage: Specifieshow much to alter the pitch based upon the difference between the delegate's pitch and the base pitch setting.

Base Pitch: Specifies the delegate pitch at which the animation should be played back at its normal rate.

Scale Playback Speed/Animation: Scales the clip's animation based on pitch.

Percentage: Specifieshow much to alter the playback speed based upon the difference between the delegate's pitch and the base pitch setting.

Base Pitch: Specifies the delegate pitch at which the animation should be played back at its normal rate.

10.3.4 PITCH VELOCITY PANEL

To have delegate pitch velocity considered for motion synthesis, turn on Use Pitch Velocity, choose Range or Unique and then make the appropriate settings.

Pitch velocity is determined by the rate of change in degrees per frame of the angle of the delegate about the world X-axis. In other words, pitch velocity measures how fast the delegate is changing its pitch.

Use Pitch Velocity: Turn on to have the motion synthesis engine consider pitch velocity in determining whether to activate the state.

Range: The motion synthesis engine activates the clip when the delegate's pitch velocity falls inside the specified range.

Range Display: After you synthesize the master motion clips, displays delegates' minimum, average and maximum pitch velocity.

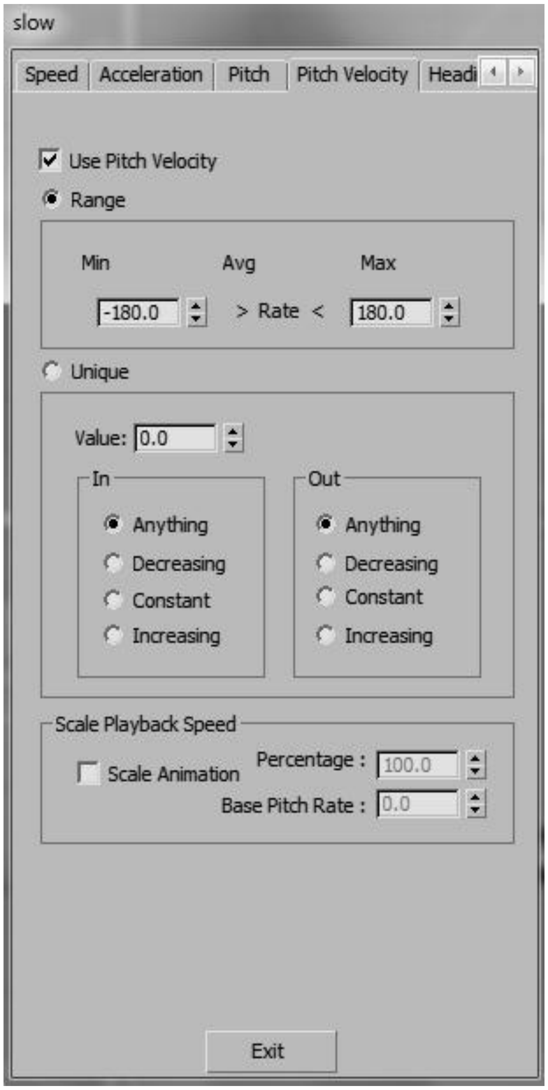

Fig. 10.6: Pitch Velocity Panel

Min: Set a minimum pitch velocity for the range.

Max: Set a maximum pitch velocity for the range.

Unique: Choose unique to have the motion synthesis engine activate the clip when the delegate's pitch velocity matches a specific value, optionally with a rising, falling or constant value before or after the specified value.

Value: Set a unique pitch velocity value.

In/Out: These radio buttons let you specify the behaviour of the parameter before and after the unique value is met.

- Anything: Pitch velocity before or after the target value is not relevant.
- Decreasing: Pitch velocity decreases before or after it reaches the target value.
- Constant: Pitch velocity before or after the target value is constant.
- Increasing: Pitch velocity increases before or after it reaches the target value. Scale

Animation: Scales the clip's animation based on pitch velocity.

Percentage: Specify how much to alter the playback speed based upon the difference between the delegate's pitch velocity and the base pitch rate setting.

Base Pitch Rate: Specifies the delegate pitch velocity at which the animation should be played back at its normal rate.

10.3.5 Heading Velocity Panel

To have delegate heading velocity considered for motion synthesis, turn on Use Heading Velocity, choose Range or Unique and then make the appropriate settings.

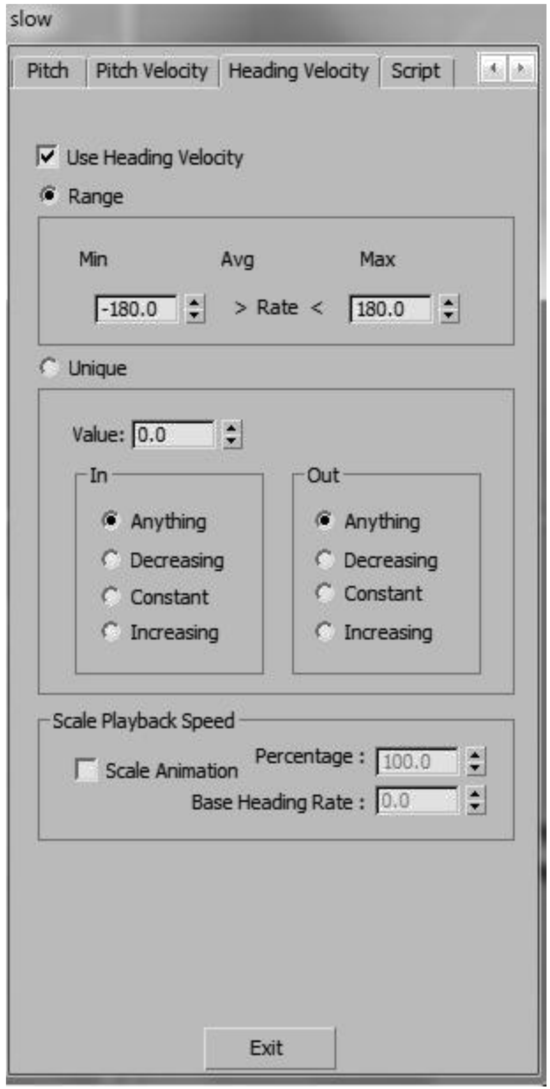

Fig 10.7: Heading Velocity Panel

Heading velocity is determined by the rate of change in degrees per frame of the angle of the delegate about the world Z-axis. In other words, heading velocity measures how fast the delegate is changing its heading.

Use Heading Velocity: Turn on to have the motion synthesis engine consider heading velocity in determining whether to activate the state.

Range: Choose range to have the motion synthesis engine activate the clip when the delegate's heading velocity falls inside the specified range.

Range Display: After you synthesize the master motion clips, displays delegates' minimum, average and maximum heading velocity.

Min: Set a minimum heading rate value for the range.

Max: Set a maximum heading rate value for the range.

Unique: Choose unique to have the motion synthesis engine activate the clip when the delegate's heading rate matches a specific value, optionally with a rising, falling or constant value before or after the specified value.

Value: Set a unique heading rate value.

In/Out: These radio buttons let you specify the behaviour of the parameter before and after the unique value is met.

- Anything: Heading velocity before or after the target value is not relevant.
- Decreasing: Heading velocity decreases before or after it reaches the target value.
- Constant: Heading velocity before or after the target value is constant.
- Increasing: Heading velocity increases before or after it reaches the target value. Scale

Animation: Scales the clip's animation based on heading velocity.

Percentage: Specify how much to alter the playback speed based upon the difference between the delegate's heading velocity and the base heading rate setting.

Base Heading Rate: Specifies the delegate heading velocity at which the animation should be played back at its normal rate.

10.3.6 Script Panel

The script state option let you create a MAXScript script that takes two parameters: node and time. The script typically tests one or more values and then returns 1 if the condition is true or 0 if it’s false. This result determines whether the state is to be activated or not.

Scripts used by the clip controller are similar to those used by the cognitive controller, with the exception that a special time-related statement is required.

Use Script: Turn this on to use a maxscript script to control a clip.

Script: Enter the name of the function defined by the script, also found at the start of the script.

Edit Script: Opens a maxscript editor window that let you edit the script.

Study Notes

Assessment

How many dialog panels are there? Name them.

Discussion

Follow the path below and explain Clip state dialog.

Track View >Hierarchy >Global Tracks >Block Control >Global Clip Properties (right-click) >Synthesis dialog >State panel >New State >Edit Properties >ClipState dialog

10.4 Synthesis Panel

Controls which are given in the Synthesis panel are for adding objects to be synthesized, selecting blend transition points and performing the synthesis.

Master Motion Clips List: This displays the objects to which the synthesized motion will be applied. you can highlight any of the object by clicking them.

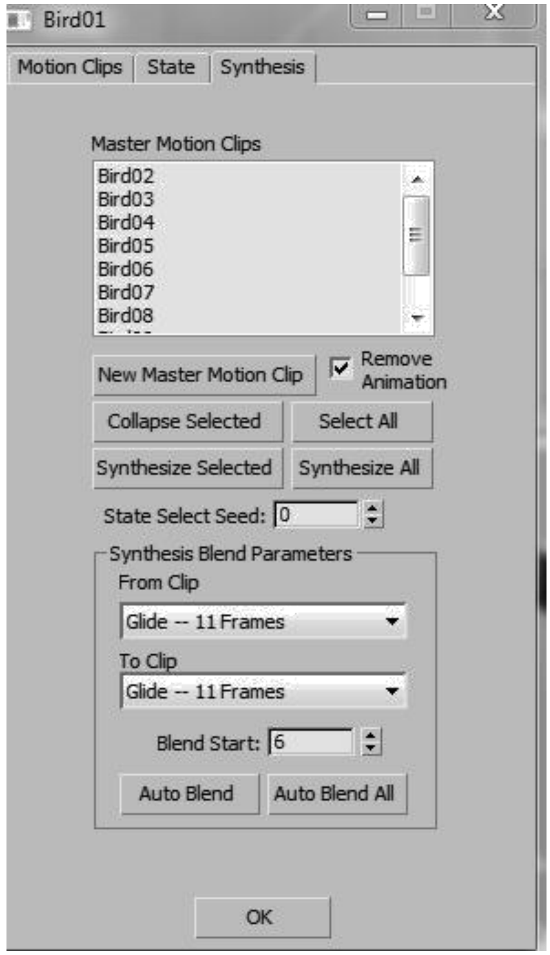

Fig. 10.8: Synthesis Panel

New Master Motion Clip: When you click this button, it displays the select object to copy dialog. you can use this to specify the objects to which the synthesized motion will be applied. these objects must be structurally identical to the global object or simply they should be clones of the global object.

Remove Animation: When checked, this strips the animation from the clones. after making clones of the original animated object, you can strip the animation from the clones. during synthesis, motion is applied based on which state is active.

Collapse Selected:When clicked, this collapses motion clips to keys on the highlighted objects. this deletes the master motion clip for that object. you can then edit keys and make changes to the animation manually in the scene.

Synthesize Selected: This analyzes the motion of the delegates linked to the highlighted objects in the master motion clips list, determines which state definitions fit that motion throughout the animation and applies the corresponding motion clips.

Select All: This selects all of the objects in the master motion clips list.

Synthesize All: This analyzes the motion of the delegates linked to all objects in the master motion clips list, determines which state definitions fit that motion throughout the animation and applies the corresponding motion clips. a progress bar is displayed during synthesis. When synthesis is completed, the synthesis dialog reappears and you can view the calculated minimum, maximum and average values of delegate motion for the different state properties in the clip state dialog. You can use these values to fine-tune the state properties.

State Select Seed: This sets a seed value for random state selection. During synthesis, it is possible that several states qualify for activation at the same time, in which case one state is chosen at random. The seed is used to modify the random value selected when determining which state to select.

Synthesis Blend Parameters Group

During synthesis, clips arenot sequenced from end to end; instead, they partially overlap, with key blending or averaging occurring during the overlap intervals. This allows for smooth transitions between clips. During the blending or overlap period, weighting gradually shifts between the “from” and “to” clips, so the former's keys predominate at the beginning of the blend and the later’s at the end.

You can specify explicitly how blending occurs between clips or you can let character studio calculate blending parameters automatically. To specify blending, use the drop-down lists to choose a pair of clips to blend between and then set Blend Start to the frame in the “from” clip at which blending should begin. Alternatively, use Auto Blend or Auto Blend All to have character studio determine the best blend points.

If you use Auto Blend, you can then see the calculated blend start point for each pair of clips by choosing the clips from the drop-down lists.

From Clip List: This list option let you select the starting clip to blend; the clip to start blend from.

To Clip List: This lets you select the ending clip to blend; the clip to blend to.

Blend Start: This displays the frame in the from clip at which the transition is to begin, whether the default, calculated or set manually and let you change the start frame.

Auto Blend:This automatically sets the blend start frame for the current from and to clips.

Auto Blend All: This Automatically Sets The Blend Start Frames For All Possible Pairs Of Clips.

OK: Click ok to accept changes and close the dialog.

Study Notes

Assessment

1. What is the function of the Synthesis panel?
2. Which option selects all of the objects in the Master Motion Clips list.

Discussion

Follow the path below and explain Clip state dialog.

Crowd >Modify panel >Global clip controllers rollout >New >Choose a Global clip object>select the object in the list >synthesis dialog >synthesis panel

10.5 Motion Mixer

The Motion Mixer allows you to mix motions for a biped's animation. The Motion Mixer takes its design from the world of audio. When a song is recorded in a studio, each instrument is played and recorded separately. Each recording is called a track. The tracks are then put together in a sound mixer so they play simultaneously or overlap one another. During the mixing process, the mixer operator can change the length or speed of a track, increase or reduce volume, move a track to another place in the song or cause a track to fade in or out.

The Motion Mixer works in a similar way. For any biped, you can add multiple tracks to the mixer, each holding a separate series of motion clips (BIP files). You can trim clips to use only part of a motion, make the clips play slower or faster or create transitions from one clip or set of clips to another

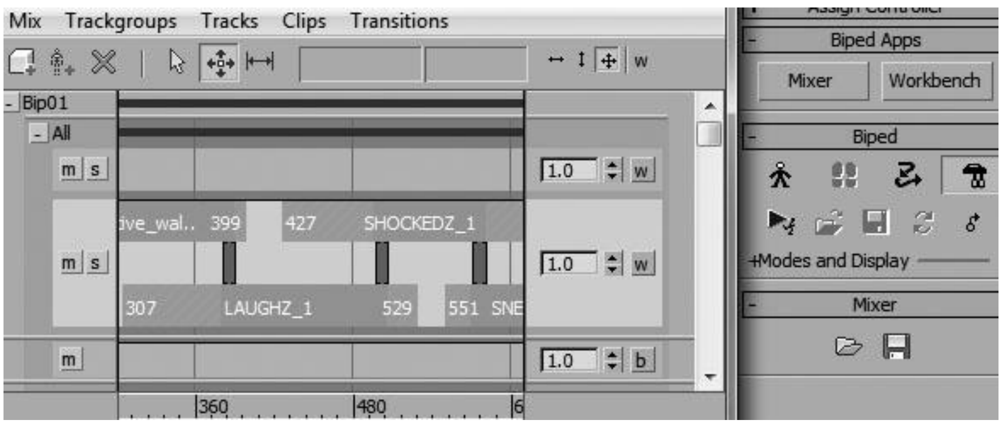

Fig. 10.9: Motion Mixer Panel

You can also use the Motion Mixer to animate some body parts with one set of clips and other body parts with other motions. For example, suppose you have two clips, one where the biped runs with its arms pumping by its sides and another where the biped stands and cheers with its arms in the air. You can mix the leg and hip motions from the running motion with the arms from the cheering motion to make an animation of a biped cheering as it runs across a finish line.

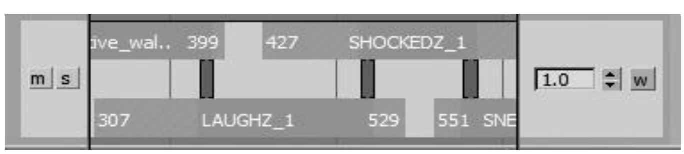

Fig. 10.10: Transition Track

The motion mixer panel can be opened by clicking the Mixer button in the Command panel-> Motion panel-> Biped Apps after selecting a biped. For inserting clips to the tracks, you can either right click at the track or choose Tracks menu-> New Clip-> From File. You can create transitions between two tracks by adding a transition track. In figure 10.10, clips are represented by light big bars and transitions are represented by the dark small bars between the big bars. To view the final motion, turn on the motion mixer mode.

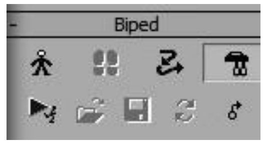

Fig. 10.11: Mixer Mode Turned On

Study Notes

Assessment

State true or false.

1. The Motion Mixer allows us to mix motions for a biped's animation.
2. The motion mixer panel can be opened by clicking the Mixer button in the Command panel-> Motion panel-> Biped Apps after selecting a biped.

Discussion

Work with motion mixer with your biped file and explain it.

10.6 State Panel

To Select the State panel following is the path.

Select Crowd >Modify panel >Global Clip Controllers rollout >New >Choose a GlobalClip object. >Select the object in the list. >Edit >Synthesis dialog >State panel

State panel has following options:

Synthesis states drop-down list

Displays the current state. Choose a state to modify from the list. You can change the state name by editing the text in the list window.

New state

Creates a new state and adds it to the list.

Delete state

Deletes the current state. This is undoable.

Edit Properties

Let you modify the current state.

Clear Properties

Returns the state to the default settings and removes clips from the MotionClips window.

MotionClips group

MotionClips window

Displays motion clips used by the current state.

MotionClip Weight

Determines the chance that a clip will be chosen during synthesis. Range=0 to 1000.

Add Clip

Displays the Select MotionClip dialog. Highlight a clip and click OK to add a clip to the current state.

Remove Clip

Removes the highlighted clip from the current state.

Precedence

Sets the precedence for the current state. Range=0 to 1000.

Weight

Specifies a weight value for a state.

Animation Start Percent

Specifies where in the clip's animation you want it to start playing when the state is active.

Animation Start Deviation

You can randomize where the animation starts by specifying a Animation Start Deviation value other than 0. Range=0.0 to 1.0.

StateActive Percent

Specifies the percentage of time the state needs to be valid over its interval in order for it to be selected. Range=0 to 100. Default=50.

Clip Select Seed

Changes how the random selections occur.

If the value stays the same, you are guaranteed to get the same random selections for that state

OK

Accepts changes and closes the dialog.

Study Notes

	Assessment
Deletestate is undoable.(True / False) Which option can create a new state and add it to the list?	

	Discussion
Follow the path and explain state panel Select Crowd >Modify panel >Global Clip Controllers rollout >New >Choose a GlobalClip object. >Select the object in the list. >Edit >Synthesis dialog >Statepanel	

10.7 Exercise One

To Use Motion Synthesis With Non-Bipedal Creatures

1. Create Clone of Object: Create clones of the object which you want to animate as crowd. While create choose the copy option instead of the instance.
2. Animate an object: Create animation in one position, like a bird's beating wings. Create a variety of animation like a gliding motion (wings still), wings beating slowly and so on. To animate the object, apply modifiers and animate their parameters. This will be the Global object, from which animation clips will be derived.
3. Create Delegates: Using the Create panel -> Helpers -> Object Type rollout; add a Crowd object and a Delegate object.
4. Cloning Delegates: Use Scatter Objects in Crowd function to clone the delegate and optionally distribute the clones (you can also distribute them manually).Make sure that there is an equal number of delegates and animated object clones.

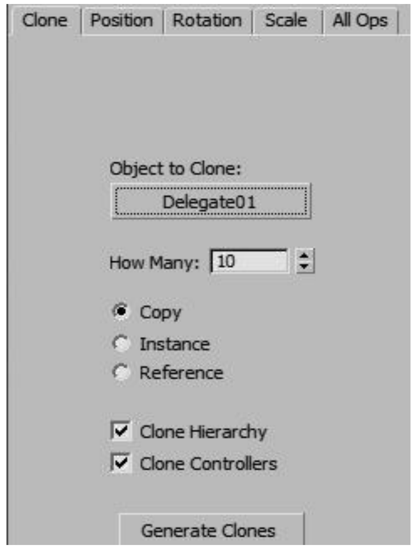

Fig. 10.12: Scatter Object

5. Associate and Link the objects to the delegates: Click the Object/Delegate Associations button.Add the objects and delegates into their respective columns.Click Align Objects with Delegates and then click Link Objects to Delegates and then click OK to exit the dialog.

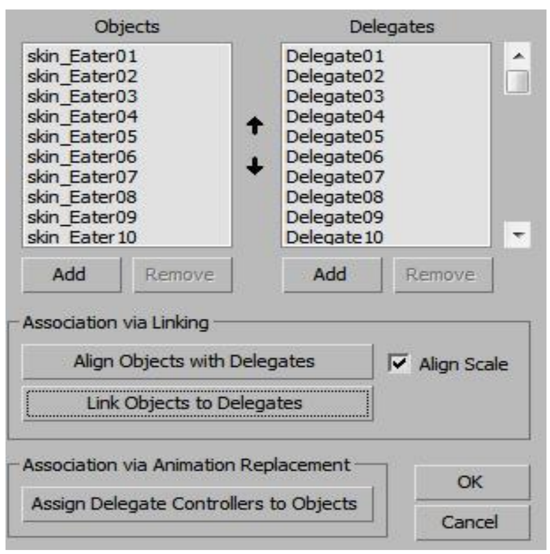

Fig. 10.13: Associate and Link Dialog

6. Animate delegates: Animate the delegates with behaviours. When you solve the simulation, the cloned objects follow the delegates, which are guided by behaviours. You then generate motion synthesis based on the delegate movement.

7. Defining Global Object: Select the Crowd object. On the Modify panel > Global Clip Controllers rollout, click New and use the Select dialog to select the Global object from

step 2.The object appears in the Global Clip Controllers rollout list.In the list, click the object and then click the Edit button; this will open The Synthesis dialog.

Fig. 10.14: Global object selected in Global Clip Controllers Panel

8. On the Motion Clips panel, turn off all check boxes in the From Global Object and Remove Local groups.On the Motion Clips panel, click New.

9. Choose a descriptive name and a frame range for the motion clip.Continue to define clips using different frame ranges from the Globalobject's animation.

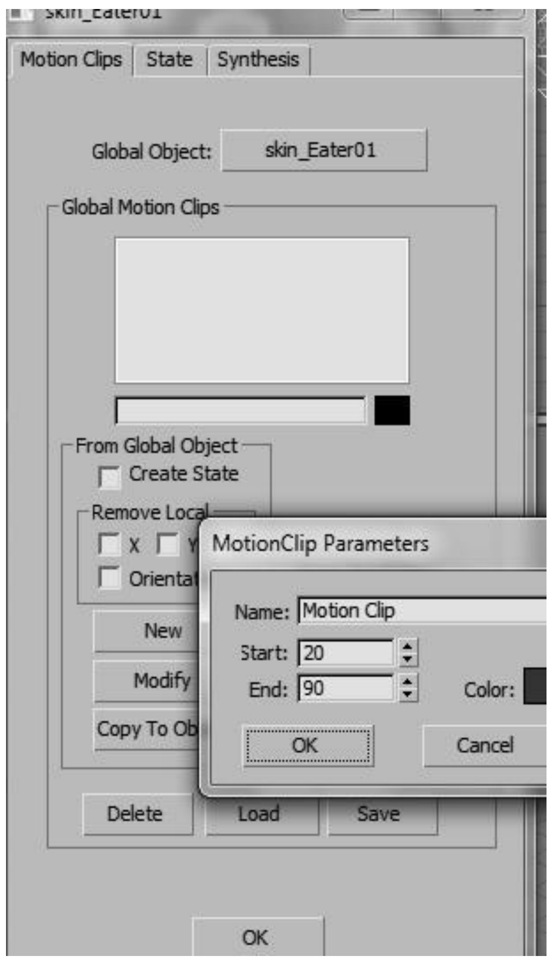

Fig. 10.15:MotionClip Parameters

10. Click the State tab and then click New State.A new state is added to the drop-down list at the top of the Synthesis States group. Give the state a descriptive name. In many cases, the state can use the same name as the motion clip that's to be associated with it.
11. Next, you specify the state's parameters; that is, how the delegate should be moving when the associated object is to use its motion clip.
12. Click Edit Properties and define how character studio should activate the clip, based on any combination of speed, acceleration and so on. Click Exit to exit the dialog.
13. When using a range, make sure the Min setting is lower than the Max setting.
14. You should already have several motion clips. Now you need to associate a clip with this state.
15. In the MotionClips group, click Add Clip and in the Select MotionClip dialog, highlight a clip and click OK.
16. Repeat steps 14 and 15 for each state to be used in motion synthesis.
17. Go to the Synthesis panel, click New Master Motion Clip and add all of the cloned objects.
18. Click Auto Blend All and then click Synthesize All.The synthesis occurs as a progress bar displays. When the synthesis is completed, the Synthesis dialog reappears. You can now view the ClipState parameters' ranges and average values by clicking State panel > Edit properties. This is useful in fine-tuning state properties.
19. Click OK to exit the Synthesis dialog.

The objects follow the delegates and are animated using clips that are activated according to delegate motion and the states you created.

	Study Notes

	Assessment
Explain Synthesis with non-bipedal creatures.	

	Discussion
Practice the exercise given above.	

10.8 Exercise Two

To use Motion Mixer with Bipedal Creatures

1. First of all model and texture your character.
2. Then Attach Biped to the model using physic modifier. After attaching check the linking.
3. Select the bip01 node and open the motion mixer from the Motion Panel-> Biped Apps - >Mixer. It will load the selected biped in the mixer.

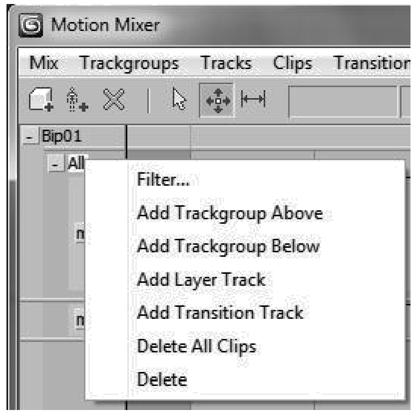

Fig. 10.16: Displaying Context Menu after Right Clicking on All.

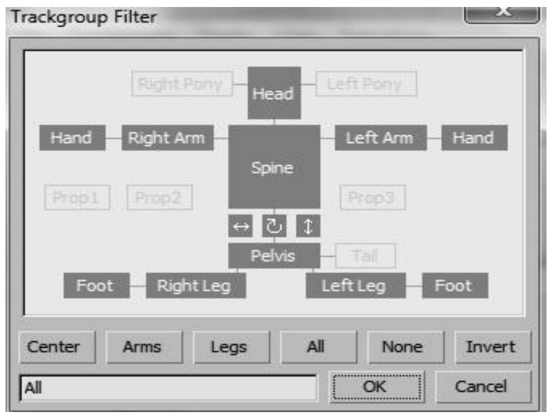

Fig. 10.17: Displaying TrackgroupFilter Dialog

You can choose to work on the entire biped or individually on the biped parts by setting the filters.

1. Right click on the track and select convert to transition track, transition tracks allow you to add transition between the two motion clips.

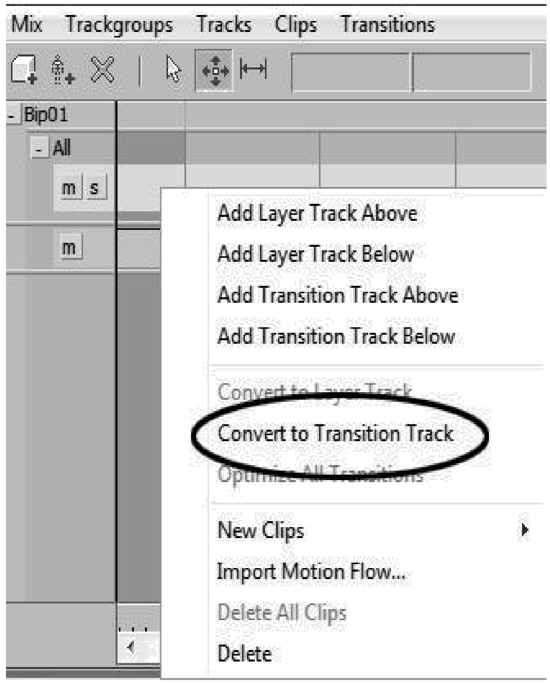

Fig. 10.18: Context Menu displaying "Convert to Transition Track" Option

2. Right Click on the transition track and then choose New Clips -> From Files. In the dialogue box browse for ".bip" files and load them into the track.

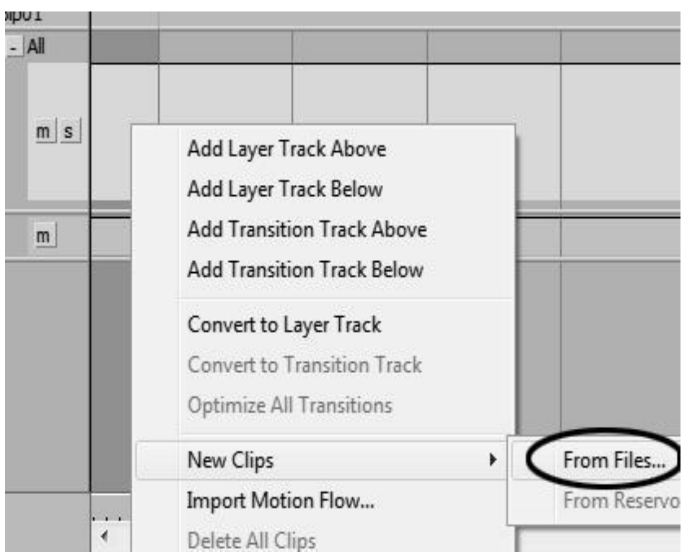

Fig. 10.19: Context Menu displaying Clip Import Option "From Files".

3. By default, the character Studio will arrange them and apply transition between them.

Fig. 10.20: Imported Clips with Transitions

4. You can click and drag the clips to change the order of the animation.
5. Right click in the transition track and select Optimize All Transitions. In the transition optimization dialog choose Search Entire Clip and click Ok. This will optimize the transitions between the clips.
6. To test the animation, click motion mixer icon in Motion Panel-> Biped-> Mixer Mode.
7. Adjust the clips or transitions if required.

Study Notes

Assessment

Explain the process of Motion Mixer with bipedal creatures.

Discussion

Practise the above exercise.

10.9 Summary

INTRODUCTION TO MOTION SYNTHESIS

Motion Synthesis is used to create customised (by combining different) motions for bipedal as well as non-bipedal crowd. The Motion Synthesis dialog is where you set up motion synthesis for non-bipedal crowd members. It uses three panels to split up the workflow.

MOTION CLIPS PANEL

On the Motion Clips panel, you specify the global object from which the motion clips are to be derived. You also set up the motion clips here.

A state is a particular property or set of properties of a delegate's animation; for example, the period during which it is pitched upwards and is decelerating. After determining the delegate's state, the motion synthesis engine chooses a motion clip for animating the object or character, linked to the delegate.

You can define a state with any combination of these properties: speed, acceleration, pitch, pitch velocity and heading velocity (plus a script). For each active property, you can specify a range or a unique value that triggers the clip for its respective state.

CLIP STATE DIALOG

You can define a state with any combination of these properties: speed, acceleration, pitch, pitch velocity and heading velocity (plus a script). For each active property, you can specify a range or a unique value that triggers the clip for its respective state.

SYNTHESIS PANEL

Controls which are given in the Synthesis panel are for adding objects to be synthesized, selecting blend transition points and performing the synthesis.

During synthesis, clips aren't sequenced from end to end; instead, they partially overlap, with key blending or averaging occurring during the overlap intervals. This allows for smooth transitions between clips. During the blending or overlap period, weighting gradually shifts between the “from” and “to” clips, so the former's keys predominate at the beginning of the blend and the latter's at the end.

MOTION MIXER

The Motion Mixer works in a similar way. For any biped, you can add multiple tracks to the mixer, each holding a separate series of motion clips (BIP files). You can trim clips to use only part of a motion, make the clips play slower or faster or create transitions from one clip or set of clips to another.

You can also use the Motion Mixer to animate some body parts with one set of clips and other body parts with other motions.

10.10 Self-Assessment Test

Broad Questions

1. What is Motion Synthesis?
2. What is Motion Mixer?
3. What are the different properties to set the state for motion synthesis?
4. How do you change a layer track into a transition track?

Short Notes

a. Motion Clips
b. Speed panel
c. Pitch and pitch velocity panel
d. State Panel
e. Synthesis Panel

10.11Further Reading

1. 3ds Max Animation with Biped, Michele Bousquet and Michael McCarthy
2. 3ds max Animation with Character Studio and Plug-Ins, Boris Kulagin and Dmitry Morozov
3. Animation with character studio 3, Michele Bousquet
4. Character Animation with 3D Studio MAX: Everything You Need to Know to Create Stunning Animation with 3D Studio MAX, Stephanie Reese
5. Fundamentals and Beyond Character Studio 4, Al Howe, Doug Barnard, Michele Bousquet, Jon Jordan, Sean Miller, AmerYassinePiaMaffei

Assignment

Use motion synthesis and motion mixer to mix various types of motions and apply it on a Biped.

Glossary

Active/Inactive Footsteps	First creation mode is inactive and the footstep having keys to animate it is active mode.
Adapt Locks	Adapt Locks can use to lock specified tracks
Adaptation	the quality to adapt key frames to edits footstep pattern
Adjust Talent Pose	to correct the biped position relative to the motion capture markers
Airborne Period	inducing the biped to become airborne
Animation Layers	making global changes to character animation
Apply Increment	to increase a set of keys in a biped track
Attachments (IK)	linking
Auto Grid	to create biped on the surface of model
Avoid Behaviour	specify any object that delegates must keep away from
Balance Factor	positions the biped's weight from COM
Ballistic Gait	in foot step patterns periods with no feet on the ground
Ballistic Tension	Controls the amount of spring or tension of biped's jump/run
Behaviours	crowd activities Simulation
Bend Links	bend all the biped spine objects by rotation
Biovision	holding skeletal and limb/joint rotation data
BIP Files	CS file format
Biped	armature used to pose a character
Biped Dynamics	computes biped airborne trajectory, knee bend on landing and positions the biped to maintain balance
Biped Playback	plays the animation for all bipeds unless they are excluded on the Display Preferences dialog
Body Space	moves the biped limbs
Bulge	using to simulate muscle contraction
Bulge Angle	a control in Physique that sets the limb angle

BVH Files	extension format of biovision
Centre of Mass (COM)	root node of biped
Character studio Marker Files	uses positional markers rather than limb rotation data
Clip Controller	used to animate non biped creatures
Cognitive Controller	sequence different behaviours using state diagrams, where in MAXScript compel changes in behaviour
Control Point	to control cross sections in envelopes, bulges and tendons.
Controller	Storing animation key values, procedural animation settings, Interpolating between animation key values
Coordinate Space	to control the biped hands and feet
Cross Section	can be moved and scaled to encompass more or less of an object
Crowd Helper Object	the command centre for setting up and solving crowd simulations
Crowd System	used in combination to animate characters
CSM Files	CSM file format for character studio Marker Files
Deformable Envelope	follow the Physique deformation spline
Deformation	caused by Physique on a mesh
Delegate Helper Objects	used in crowd animation
Delegates	an agent for motion created by a Crowd object
Double Support Period	both the biped feet are on the ground
Dynamics	computes biped airborne trajectory, knee bend on landing and positions the biped to maintain balance
Dynamics Blend	between biped and spline dynamics
Editable Meshes	Physique will work on any point based objects
Envelopes	to control skin deformation
FFD (Free Form Deformation)	used for dancing cars and gas tanks
Figure Mode	to fit a biped to the mesh

Filtering	motion capture data reduces keys, making the job of altering
Foot States	have four states like touch, plant, lift and move
Footstep Animation	allows animators to use footsteps to create movement
Footsteps Method	the natural adaptation of the biped that occurs when the footsteps are edited in time and space
Forward Kinematics	Using an arm to move a hand
Freeform Animation	to animate character poses with and without the aid of footsteps
Freeform Method	poses every joint of your character as you want
Gait Pattern	created by a pace like walk
Gait Type	walk, run and jump
Geometric Primitives	basic primitive objects
Gizmo	to edit the biped's feet by footstep
Global Motion Clip Controller	contains the movement to animate a non bipedal crowd
GravAccel	Gravitational Acceleration
Gravity	keeps the biped on proper position
Helper Object	to help set up an animation in viewport and non renderable
IK Blend	to interpolate an intermediate position
In Place Mode	biped will visible in the viewports while the animation plays
Initial Pose	original position of the model before applying physique
Initialise	envelopes around the limbs to control the mesh
Instance	exchangeable clone of the original
Interpolation	computes of intermediate values
Inverse Kinematics	moving a hand to position the arm
Keyframe Animation	record the beginning and end of each transformation of model
Layers	making global changes to character movement
Lift	state of a foot
Links	form the hierarchical chain

Marker Data	data from a motion capture device
Marker Files	file from a motion capture device
Markers	coating objects placed on talent in a motion capture session
Master Motion Clip Controller	consists of a list of motion clips
Mirroring	to mirror the entire biped animation
Motion Blending	transitions, to blend clips
Motion Capture	digitize a character's movements
Motion Clip	specifying a specific motion
Motion Files	variety of motion files like bip, csm, etc
Motion Flow	combine bip files
Motion Flow Editor	manually create a transition between two clips
Motion Flow Mode	combines bip files
Motion Flow Scripts	created manually or automatically
Motion Synthesis	combining motions automatically by Crowd system
N Links	number of overlapping envelopes can influence vertices
Object Instance	interchangeable clone of the original
Object Space	place a biped limb into the space of other object
Obstacle Avoidance Behaviour	closes up a crowd member's progress and encountering objects respectively.
Optical Markers	use of reflective markers by motion capture equipment
Orientation Behaviour	can control the delegates by rotation and their own direction.
Patch Based Objects	Object itself made by patches.
Path Follow Behaviour	direct delegates to traverse a specified path during a crowd simulation
Period	period between footsteps where can animate the biped as you want.

Phases of Leg Motion	four phases as the foot on the ground, the foot lifts, moves through the air and returns to the ground again
PHY Files	file format to save physique data
Physique	gives up the movements of an underlying skeleton to seamlessly move the mesh like bones
Plant	state of foot flat on a footstep
Poses	can cut and paste poses
Position Markers	reflective objects aimed on talent in a motion capture session
Prop Bone	CSM marker file supports a prop bone
References	one way instances
Reinitialise	for adding new bone in influence of physique
Repel Behaviour	specify any object that will force delegates to move away
Rubber Band Mode	a way to proportion the arm and leg links at the same time, by moving the link with the Move transform or else using scale
Scale Stride	changes the width or length for the selected footsteps
Scripted Behaviour	bounded by MAXScript
Scripts	list of clips that are carry out sequentially to animate a character
Seek Behaviour	specify any object as a moving target for delegates
Sliding Footstep	biped change foot key parameters enables the biped feet to slide
Space Warp Behaviour	allow to allot a space warp to a delegate
Spline Dynamics	create centre of mass keys, without gravity and balance calculation, for new footsteps
Support Period	one/both of the biped feet are on the ground
Surface Arrive Behaviour	assign an object as moving target for delegates
Surface Follow Behaviour	moves delegates with respect to object surfaces, whether still or animated
Synthesis, Synthesize	calculating motions for crowd simulations

Talent Figure Mode	to scale the biped relative to the markers
TCB	Tension, Continuity and Bias
Tendons	to control the amount of skin stretching over multiple links
Tension, Continuity, Bias	to change the trajectory of a limb through keys
Touch	state of the first frame of a footstep
Trajectory	the visible path the object makes due to its movement
Transform Gizmo	to transform or rotate the biped objects
Vector Field	to move around irregular objects
Vector Field Space Warp	to guide delegates around the object by moving them perpendicular to the vectors
Velocity Interpolation	a transition between two motion clips
Walking Gait	the feet moving from a left foot support, then both feet support and then right foot support
Wall Repel Behaviour	delegates turn until they're heading away from the grid
Wander Behaviour	simulate meandering activity in which delegates move and turn in a slipshod manner
Workflow	to perform a task for steps
World Space	move the centre of mass and have the feet stay planted in space