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Preface

This manual is written for persons who will install DI-Guy® or use the DI-Guy application. The manual assumes that you are familiar with your operating system and that you know how to work in your computer's graphical window environment.

Please see release documentation for information about changes and updates to DI-Guy since this manual was completed.

How This Manual Is Organized

The chapters are organized as follows:

"Chapter 1. Introduction to the DI-Guy Motion Editor" on page 21 briefly describes DI-Guy Motion Editor and its features.

"Chapter 2. Tutorials" on page 27 walks you through basic tasks using the DI-Guy Motion Editor.

"Chapter 3. The 3D View" on page 47 describes the 3D window and its features.

"Chapter 4. Using the Timeline" on page 61 explains how to build motions on the timeline.

"Chapter 5. Editing Joints" on page 83 explains how to edit joints using the joint editor.

"Chapter 6. Configuring the Camera" on page 89 describes camera settings and how to create them.

"Chapter 7. Editing Action Tables" on page 101 explains action tables, which let you specify many parameters for a character's actions.

"Chapter 8. Editing Gestures and Gesture Tables" on page 123 describes gestures, which are actions applied to a subset of a character's DOF during an action.

"Chapter 9. Importing and Exporting Motions" on page 133, explains how to import motions from other applications and how to export them.

"Chapter 10. Importing Motion Capture Data" on page 141 explains how to process motion capture data in Autodesk MotionBuilder and import it into DI-Guy.

"Chapter 11. Hot Keys" on page 143 lists keyboard shortcuts for common DI-Guy Motion Editor actions.

"DI-Guy Glossary" on page 147 defines DI-Guy-specific terms.

Documentation

DI-Guy comes with the following documentation:

- *DI-Guy SDK Developers Guide*. Online documentation that lists all the functions and classes of DI-Guy SDK and explains how to program using the DI-Guy SDK.
- *DI-Guy Documentation Center*. Includes HTML versions of all of the books listed below, allowing you to search the entire documentation set. It also includes links to developer documentation and the PDF versions of the guides.
- *DI-Guy Getting Started Users Guide*. Explains the basics of installing and using DI-Guy products.
- *DI-Guy Scenario Users Guide*. Explains how to use DI-Guy Scenario to create scenarios with realistic human activity.
- *DI-Guy Content Reference Manual*. Explains how to customize DI-Guy characters and add new character models. It also describes how to use DI-Guy Expressive Faces.
- *DI-Guy AI Users Guide*. Explains how to use DI-Guy AI to add intelligent behavior to DI-Guy characters.

- *DI-Guy Motion Editor Users Guide*. Explains how to import, edit, and customize DI-Guy motions.

These documents are available from the start menu under DI-Guy, or by browsing to `./doc`.

Try the Help

The *DI-Guy Documentation Center* is the best way to use MAK's documentation. It's easy to navigate, with improved natural language search tools and filters to focus your search. You can click the illustrations to see high-resolution enlargements that show more detail. It's installed locally: you do not need to be connected to the internet to use it.

 If you attempt to view the help in a browser that does not support HTML5, you may experience issues with some features.

Derivative Work

Any DI-Guy content (model, texture, motion, and so on) that you modify or copy is a derivative work that is protected under copyright law by the same rules that apply to content delivered with DI-Guy. This derivative content may be used only on computers that have a valid DI-Guy license. Please contact MAK Technologies to discuss licensing for other uses of derivative models.

MAK Products

The MAK Technologies product line includes the following:

- **VR-Link® Network Toolkit**. VR-Link is an object-oriented library of C++ functions and definitions that implement the High Level Architecture (HLA) and the Distributed Interactive Simulation (DIS) protocol. VR-Link has built-in support for the NETN FOM and RPR FOM and allows you to map to other FOMs. This library minimizes the time and effort required to build and maintain new HLA or DIS-compliant applications, and to integrate such compliance into existing applications. VR-Link includes a set of sample debugging applications and their source code. The source code serves as an example of how to use the VR-Link Toolkit to write applications. The executables provide valuable debugging services such as generating a predictable stream of HLA or DIS messages, and displaying the contents of messages transmitted on the network.
- **MAK RTI**. An RTI (Run-Time Infrastructure) is required to run applications using the High Level Architecture (HLA). The MAK RTI is optimized for high performance. It has an API, RTIspy®, that allows you to extend the RTI using plug-in modules. It also has a graphical user interface (the RTI Assistant) that helps users with configuration tasks and managing federates and federations.
- **VR-Forces®**. VR-Forces is a computer generated forces application and toolkit. It provides an application with a GUI, that gives you 2D and 3D views of a simulated environment.

You can create and view entities, aggregate them into hierarchical units, assign tasks, set state parameters, and create plans that have tasks, set statements, and conditional statements. You can simulate using entity-level modeling, which focuses on the actions of individual people and vehicles, and aggregate-level modeling, which focuses on the interaction of large hierarchical units.

VR-Forces also functions as a plan view display for viewing remote simulation objects taking part in an exercise. Using the toolkit, you can extend the VR-Forces application or create your own application for use with another user interface.

- **VR-Vantage™.** VR-Vantage is a line of products designed to meet your simulation visualization needs. It includes VR-Vantage and the VR-Vantage Toolkit.
 - VR-Vantage displays a realistic, 3D view of your virtual world, a 2D plan view, and an exaggerated reality (XR) view. Together these views provide both situational awareness and the big picture of the simulated world. You can move your viewpoint to any location in the 3D world and can attach it to simulation objects so that it moves as they do.
 - SensorFX. SensorFX is an enhanced version of VR-Vantage that uses physics-based sensors to view terrain and simulation object models that have been materially classified. It is built in partnership with JRM Technologies.
 - The VR-Vantage Toolkit is a 3D visual application development toolkit. Use it to customize or extend MAK's VR-Vantage applications, or to integrate VR-Vantage capabilities into your custom applications. VR-Vantage is built on top of OpenSceneGraph (OSG). The toolkit includes the OSG version used to build VR-Vantage.
- **MAK Data Logger.** The Data Logger, also called the Logger, can record HLA and DIS exercises and play them back for after-action review. You can play a recorded file at speeds above or below normal and can quickly jump to areas of interest. The Logger has a GUI and a text interface. The Logger API allows you to extend the Logger using plug-in modules or embed the Logger into your own application. The Logger editing features let you merge, trim, and offset Logger recordings.
- **VR-Exchange™.** VR-Exchange allows simulations that use incompatible communications protocols to interoperate. For example, within the HLA world, using VR-Exchange, federations using the HLA RPR FOM 1.0 can interoperate with simulations using RPR FOM 2.0, or federations using different RTIs can interoperate. VR-Exchange supports HLA, TENA, and DIS translation.
- **VR-TheWorld™ Server.** VR-TheWorld Server is a simple, yet powerful, web-based streaming terrain server, developed in conjunction with Pelican Mapping. Delivered with a global base map, you can also easily populate it with your own custom source data through a web-based interface. The server can be deployed on private, classified networks to provide streaming terrain data to a variety of simulation and visualization applications behind your firewall.
- **DI-Guy™.** DI-Guy is an SDK that allows you to embed the DI-Guy library in your real-time application and populate your world with lifelike human characters. DI-Guy provides high-fidelity human characters that move realistically, respond to simple high-level commands, and travel throughout the environment as directed by the

hosting visual application. It comes with thousands of ready-to-use characters, appearances, and motions. DI-Guy character simulation is an integral part of all MAK's visual applications, including VR-Engage, VR-Forces, and VR-Vantage.

- **RadarFX.** RadarFX is a client-server application that simulates synthetic-aperture radar (SAR). The server application, which is based on VR-Vantage and SensorFX, loads a terrain database and, optionally, connects to simulations. A client application requests SAR images from the server. RadarFX includes a sample client application.
- **VR-Engage.** VR-Engage is a multi-role virtual simulator that lets users play the role of a first person human character, a ground vehicle driver, gunner or commander, a sensor operator, or the pilot of a fixed wing aircraft or helicopter. It incorporates the VR-Force simulation engine and the VR-Vantage graphics rendering capabilities.
- **WebLVC Server.** WebLVC Server implements the server side of the WebLVC protocol so that web-based simulation federates can participate in a distributed simulation. It is part of the WebLVC Suite, which includes the server and several sample applications that work with VR-Forces and VR-Vantage.
- **MAK Legion.** MAK Legion is a collection of applications and an SDK designed to support simulations with millions of simulation objects.

How to Contact Us

For DI-Guy Motion Editor technical support, information about upgrades, and information about other MAK products, you can contact us in the following ways:

Telephone

Call or fax us at:	Voice: 617-876-8085
	Fax: 617-876-9208

E-mail

Sales and upgrade information:	info@mak.com
Technical support:	support@mak.com

Internet

MAK website home page:	www.mak.com
License key requests:	www.mak.com/support/get-licenses
Technical support:	www.mak.com/mak-one/support/portal
Product version and platform information:	www.mak.com/support/product-versions
For the free, unlicensed MAK RTI:	www.mak.com/support/bonus-material

Post

Send postal correspondence to:	MAK Technologies 10 Fawcett Street, Suite 204 Cambridge, MA 02138 USA
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When requesting support, tell us the product you are using, the version, and the platform on which you are running. If you are using VR-Vantage, VR-Forces, VR-Engage, or DI-Guy, please also include your data compatibility version and date.

Document Conventions

This manual uses the following typographic conventions:

Sans Serif Bold	Indicates a key on the keyboard or menu options. Also indicates parameters.
Monospaced	Indicates values you enter such as commands or arguments.
<i>Monospaced</i>	Indicates command variables that you replace with appropriate values.
<i>Italic</i>	
{ }	Indicates required arguments.
[]	Indicates optional arguments.
	Separates options in a command where only one option may be chosen at a time.
()	In command syntax, indicates equivalent alternatives for a command-line option, for example, (-h --help).
/	Indicates a directory. Since MAK products run on both Linux and Windows PC platforms, we use the / (slash) for generic discussions of pathnames.
<i>Italic</i>	Indicates a file name, pathname, or a class name.
➤	Indicates a procedure.
Menu > Option	Indicates a menu choice. For example, an instruction to select the Save option from the File menu appears as: Choose File > Save .
	Indicates supplemental or clarifying information.
	Indicates additional information that you must observe to ensure the success of a procedure or other task.

Directory names are preceded with dot and slash characters that show their position with respect to the DI-Guy home directory. For example, the directory *./DI-Guy13.7/doc* appears in the text as *./doc*.

DI-Guy Conventions

The following table lists the conventions used for entity coordinates in DI-Guy documentation.

Convention	Indicates
XYZ	X = forward, Y = to the left Z = up
Yaw, Roll, Pitch	Orientation is applied in the order YRP. Yaw = rz – orientation about the vertical axis Roll = rx – orientation about the fore-aft axis Pitch = ry – orientation nose down, nose up

Mouse Button Naming Conventions

An instruction to click the mouse button refers to clicking the primary mouse button, usually the left button for right-handed mice and the right button for left-handed mice. The context-sensitive menu, also called a popup menu or right-click menu, refers to the menu displayed when you click the secondary mouse button, usually the right button on right-handed mice and the left button on left-handed mice.

Third-Party Licenses

MAK software products may use code from third parties. This section contains summary license information and, where required, specific license documentation required by these third parties.

Third-Party Libraries Supported

DI-Guy 13.7 uses the indicated versions of the following libraries:

- VR-Link 5.9
- Qt 5.15.2 (VC 15 and Red Hat 8)
- OpenSceneGraph 3.6.4
- Boost 1.63.0
- FreeGlut 2.4.0 (Windows), 2.6.0 (Linux)
- GL Studio 8.2
- DI-Guy 13.7 (development version)
- Triton 4.43
- SilverLining 6.20
- SpeedTree 6.3.2
- CDB API 2.2 (Windows), 2.1 (Linux)
- osgEarth 3.2
- CUDA 11.7

Library Licensing

The following libraries are covered by the GNU Lesser General Public License (LGPL) license:

- CIGI
- DevIL
- GEOS
- GStreamer
- LibIconV
- LibWebSockets
- OPCode
- OpenAL
- OSG
- OsgEarth
- Pthread
- Qt
- Qwt

The following libraries are covered by the ZLib license:

- Bullet Physics
- LibPNG
- LibSDL
- Minizip
- Zlib

The following libraries are covered by the MIT license:

- Expat
- FreeGLUT
- GDAL
- GeoTIFF
- GLM
- HarfBuzz
- LibCURL
- LibSquish
- LibXML
- LUA
- LuaBind
- Proj
- SMHasher
- TCLAP
- Qt Visual Graph Editor
- ZeroBrane Studio

The following libraries are covered by the BSD license:

- FreeType
- GLEW
- JPEG
- LibTiff
- Protobuf
- PCRE
- Ogg Vorbis
- WebP

The following libraries are covered by the commercial licenses:

- FLEXlm
- Gameware
- GLStudio
- JRM Technologies SenSimRT and SigSimRT
- OpenFlight
- SpeedTree
- Sundog Triton
- Sundog SilverLining
- CDB API

The following libraries are covered by custom licenses:

- NVIDIA CG Toolkit
- FreeImage (FreeImage Public License)
- Boost (Boost Software License)
- Poco (Boost Software License)

COLLADA DOM is covered by the SCEA Shared Source license.

Thread Building Blocks is covered by the GPL license:

SQLite is in the public domain.

SWIG is covered by the GPL license.

Boost License

VR-Link, and all MAK ONE products that use VR-Link, uses some code that is distributed under the Boost License. All header files that contain Boost code are properly attributed. The Boost website is: www.boost.org.

Boost Software License - Version 1.0 - August 17th, 2003

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libXML and libICONV

VR-Link, and all MAK ONE products that use VR-Link, links in libXML and libICONV. On some platforms the compiled libraries and header files are distributed with MAK products. MAK has made no modifications to these libraries. For more information about these libraries, see the following websites:

- The LGPL license is available at: <http://www.gnu.org/licenses/lgpl.html>.
- Information about IconV is at: <http://www.gnu.org/software/libiconv>.
- Information about LibXML is at: <http://xmlsoft.org>.

Lua

Some MAK products use the Lua programming language (www.lua.org). Its license is as follows:

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1. Introduction to the DI-Guy Motion Editor

This chapter provides a brief description of DI-Guy Motion Editor features.

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1.1. Introducing DI-Guy Motion Editor

DI-Guy Motion Editor is a graphical tool for creating, editing, and adding motions to the DI-Guy motion engine.

The tool allows you to:

- Load and edit motions from the DI-Guy motion library.
- Create entirely new motions.
- Import motions using the BVH format.

The DI-Guy Motion Editor features a timeline-based editing tool for editing 3D human motion data and immediately reviewing the results. The editor features a number of blending and interpolation functions for rapid motion development.

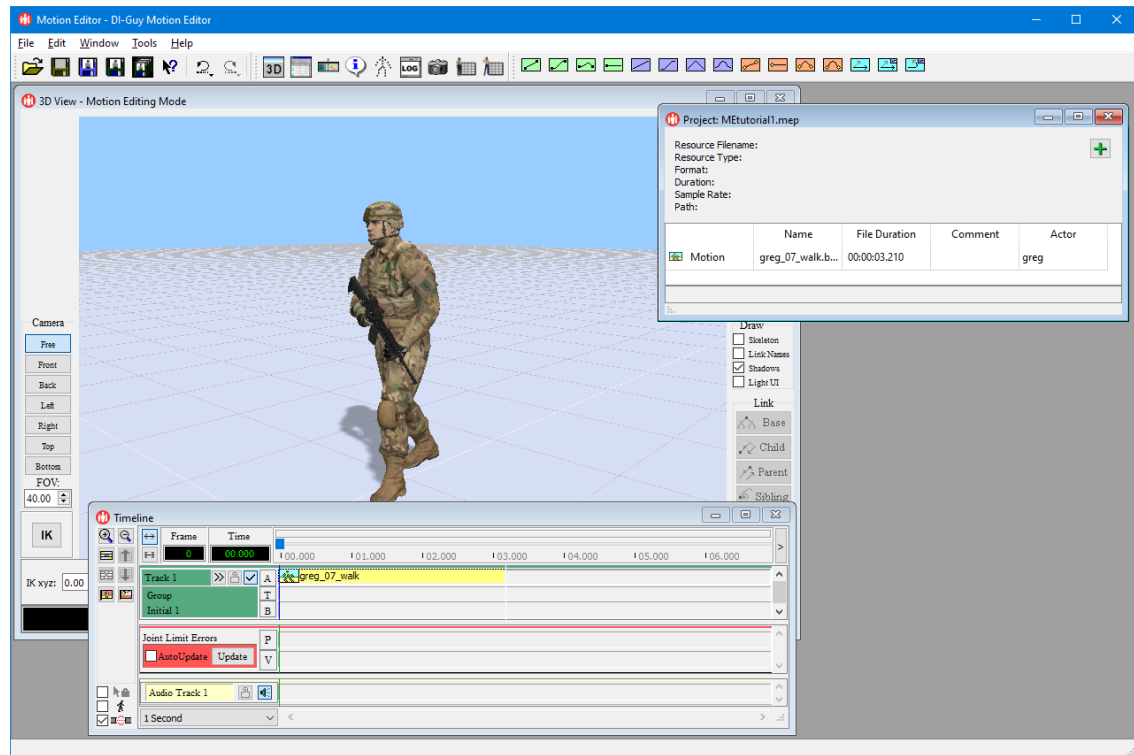
Characters are displayed in a realtime 3D window and reflect the latest motion changes from the timeline. A forward kinematics and inverse kinematics based poser tool lets you directly manipulate the character to create new poses for the character to use for motion creation.

Using the Action Table Editor, you can integrate new motions into the DI-Guy motion engine and even create new actions. Once integrated, these new motions and actions are available throughout DI-Guy as if those motions were shipped with the product. All changes are stored in the custom directory, so custom motions can be easily propagated to other DI-Guy-enabled applications.

The Action Table Editor also lets you review the suite of actions used by the selected character in DI-Guy and the transitions between those actions. It is recommended that the DI-Guy Character Viewer be used as a final check on motion editing work.

The DI-Guy Motion Editor is designed to customize motions for DI-Guy SDK and DI-Guy Scenario.

Figure 1. The DI-Guy Motion Editor



1.2. Installing DI-Guy Motion Editor

DI-Guy Motion Editor is installed automatically as part of the DI-Guy product suite.

1.3. Starting DI-Guy Motion Editor

You can start DI-Guy Motion Editor from the Windows Start menu or the command line.

- To start DI-Guy Motion Editor, choose **MAK Technologies > DI-Guy Motion Editor (64-bit)**.

1.3.1 Command Line Options

Although you will usually start the Motion Editor from the Start menu, you can also start it from the command line. The command line arguments for starting DI-Guy Motion Editor are:

```
DIGuyMotionEditor -c character -a appearance
-c filename.cfg -g -v filename.csv -p filename.mep -t time -i
filename.mec
```

Table 1. Command line arguments

Argument	Description
<code>-c character</code>	Specifies the character (for example, <code>-c soldier</code>). If <code>-c</code> is omitted, the Motion Editor prompts you with a list of characters and appearances from which to choose.
<code>-a appearance</code>	Specifies an appearance for the character. If you want to know what appearances are available, do not enter a character and the Motion Editor will prompt you for a character and appearance. Select the character you want, and you will then see all of its available appearances.
<code>-C filename.cfg</code>	Specifies the configuration file to be used. If not specified, <i>diguy.cfg</i> is used. Configuration files specify the available characters, appearances, and skeletal information.
<code>-v filename.csv</code>	Specifies a .csv filename to be used for motion export.
<code>-p filename.mep</code>	Specifies a project file to be loaded.
<code>-t time</code>	Specifies DT for the Motion Editor in seconds. All output motions will use this DT between frames, so it determines the data frame-rate.
<code>-i filename.mec</code>	Specifies a camera/IK settings file.
<code>-g</code>	Specifies generic character (<code>-nodiguy</code> automatically implies this).
<code>-nodiguy</code>	Specifies a non-DI-Guy character. Non-DI-Guy characters do not have action tables associated with them.
<code>-notools</code>	Specifies that the Tools menu is not displayed.
<code>-noaudio</code>	Specifies that the audio track and audio-related features are not displayed.
<code>-nojointlimit</code>	Specifies that the joint limit track is not displayed.
<code>-noik</code>	Specifies that IK-related features are not displayed.

1.4. Projects

When you edit a character's motion, you do so in the context of a project.

1.4.1 Creating a New Project

► To create a new project:

1. Choose **File > New Project**. The Character Selection dialog box opens.
2. Select a character and appearance.
3. Click OK.

1.4.2 Saving a Project

► **To save a project:**

1. Choose **File > Save Project**. A Save dialog box opens.
2. Type a name for the project.
3. Click Save.

1.4.3 Opening the Project Window

The Project window lets you view all of the assets in the project.

► **To open the Project window, choose **Window > Project**.**

1.4.4 Importing a Project

You can import a project into the current project. The tracks from the imported project are appended to the current tracks and any new assets are added into the Project window. The DT of the current project is maintained and all data is quantized to match the current project DT. Imported projects must match the character type of the existing project.

► **To import a project:**

1. Choose **File > Import > Project**. A file browser opens.
2. Select the project to import.
3. Click Open.

1.4.5 Consolidating Project Assets (Project Local)

The project local option forces all external assets associated with a project, including the project file itself, to all be copied into a single directory. This makes it easy to copy a project from one machine to another. Once project local is enabled, new external assets are automatically placed in the project local directory

► **To consolidate project assets:**

1. Choose **File > Preferences > Project Local**. The Project Local Directory dialog box opens.
2. Type the path for the directory where you want to consolidate project files.

1.5. Viewing the Log

DI-Guy Motion Editor maintains a log of notifications, warnings, and debug information.

► **To open the Log, choose **Window > Log**.**

1.6. Running a Script

You can run Lua scripts that access the DI-Guy SDK to test motions.

► **To run a script:**

1. Choose **Tools > Run Script**. A dialog box opens.
2. Specify the script to run.
3. Click OK.



2. Tutorials

This chapter introduces you to several basic DI-Guy Motion Editor activities.

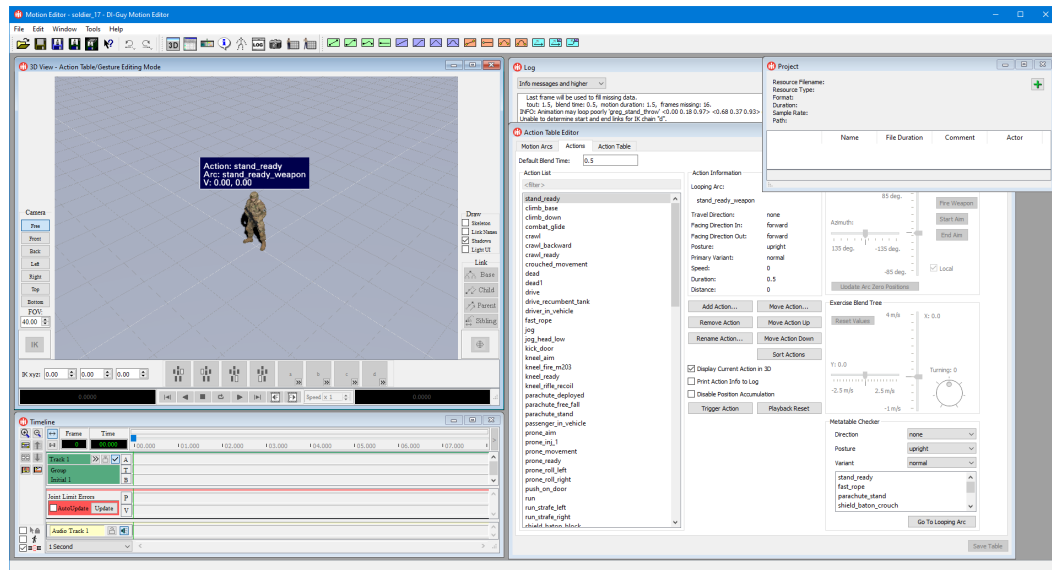
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2.1. Review the Action Table of a Character

This tutorial shows you how to preview a character's action and introduces the action table.

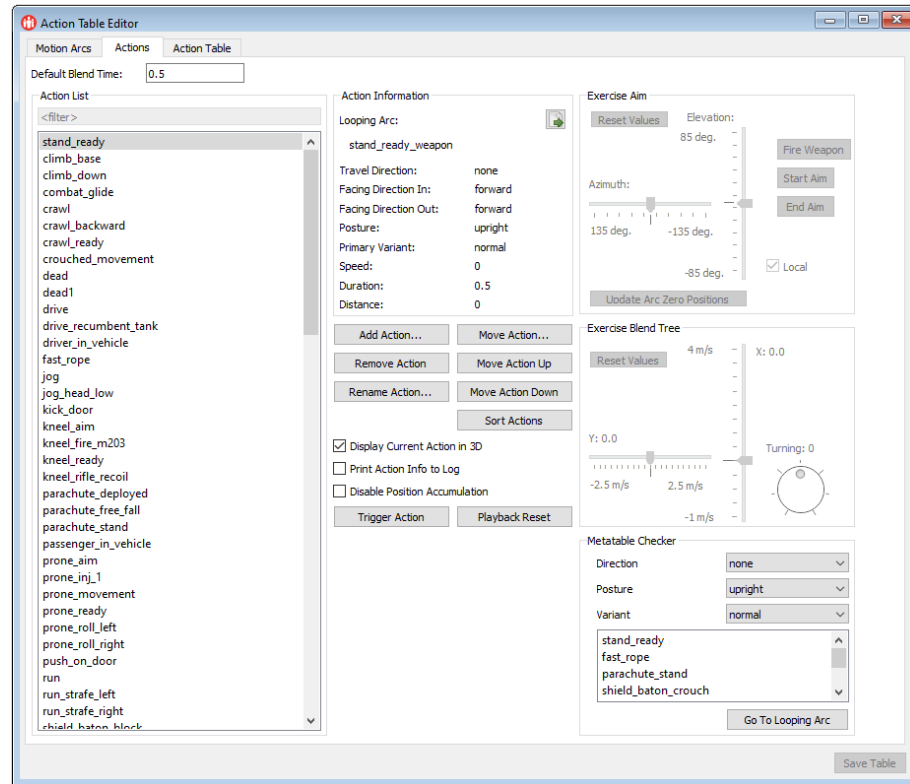
1. Start the Motion Editor.
2. Select soldier_17 as the character type. The character displays in the 3D View and other windows, such as the Timeline, open (Figure 2).

Figure 2. Motion Editor with character selected



3. If the Action Table Editor is not open, choose **Window > Action Table**. The Action Table Editor opens (Figure 3).

Figure 3. Action Table Editor, Actions tab

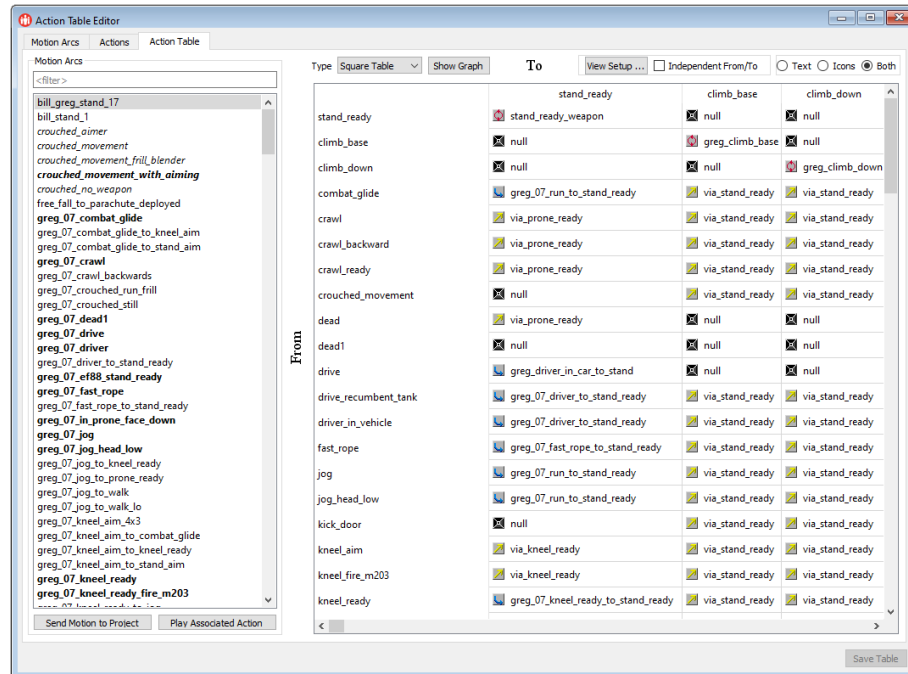


Non DI-Guy users who use characters without action tables should go to "2.2. Playing a Motion on the Timeline" on the next page to continue the tutorial.

4. In the Actions tab, double-click **walk** in the Action List. The soldier starts walking in the 3D View.
5. Click the Playback Reset button to put the character back at the 3D origin.
6. Double-click other actions to see them play. Using this method, you can review the looping motions that make up the action and the transition motions that get played when going from one action to a different action.
7. Click Playback Reset to stop the action and return the character to the starting point.
8. Select the Action Table tab (Figure 4).

In the Action Table tab, most DI-Guy character types display a square table. The square table describes which motions are played when moving from one action to another. The *from* action is described horizontally while the *to* action is described vertically. The cells along the diagonal from upper left to lower right are addressed by the same action name both vertically and horizontally (for example, From walk To walk) and indicate the looping motion used by that motion. The contents of the action table, including the table size and the names of the motions shown, are specific to each character type.

Figure 4. Action Table Editor, Action Table tab



2.2. Playing a Motion on the Timeline

This tutorial shows how to load a motion into a project and play it on the timeline. In this tutorial, you will:

- Create a new project.
- Learn about the camera buttons in the 3D View.
- Learn how to move the camera.
- Load a motion into the project.
- Preview the motion.
- Drop a motion on the Timeline.

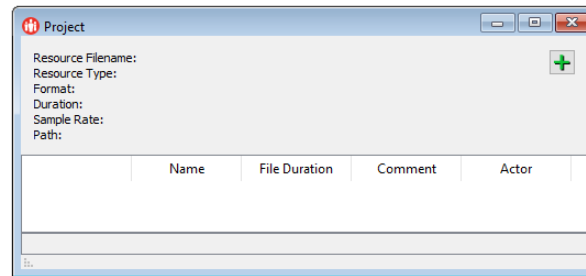
2.2.1 Create a New Project

When DI-Guy Motion Editor is first opened, by default, the software asks to select a character and appearance. Then it opens a new project with that character and appearance as the working actor. For this exercise, use the default character and appearance.

1. Start the Motion Editor.
2. Select soldier_17 as the character type. The character displays in the 3D View and some other windows, such as the Timeline (2.1 on page 28).
3. If the Project window is not open, choose **Window > Project**. The Project window opens (Figure 5).

4. In a new project, the character's zero pose is derived from the configuration file (*diguy.cfg*) and the Project window is empty (Figure 5).

Figure 5. Project window



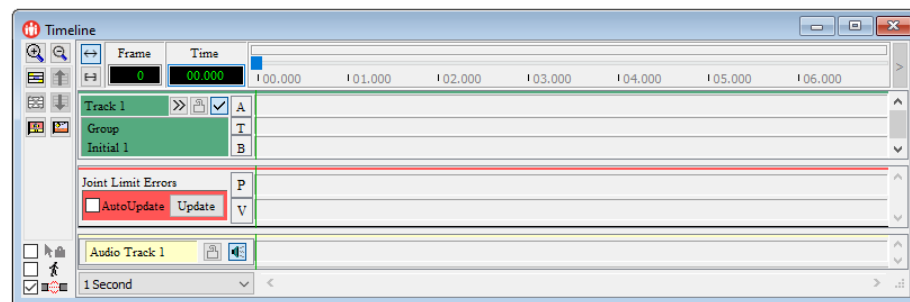
By default, a new character's origin is (0,0,0). The XY grid penetrates the character at the origin of its base joint (center of the hips). (For more information, see "3.2. Pose Edit Mode" on page 50.)

2.2.2 Use the Default Camera Buttons

The 3D View receives its input for how the character is posed from one of three sources: the Timeline, the Action Table Editor, or Motion Preview. Whichever of these widgets last had mouse focus controls the 3D View.

1. In this tutorial, the Timeline should have control of the 3D View. Select the Timeline window to give it control (Figure 6).

Figure 6. Timeline window



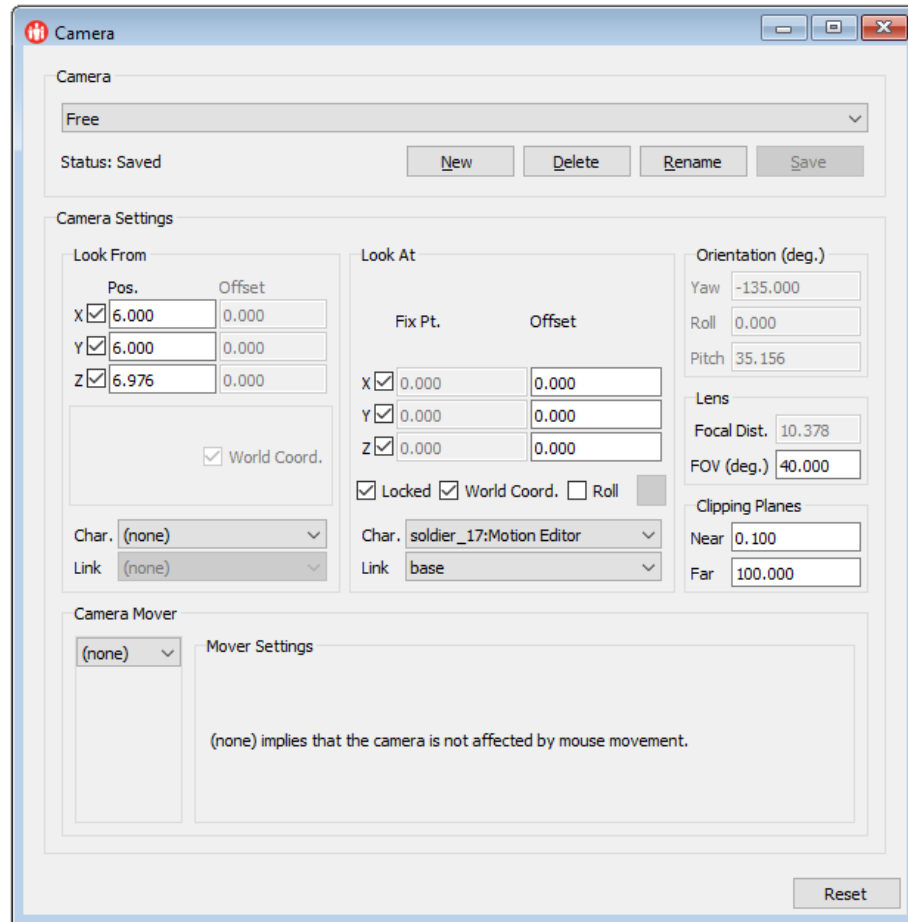
2. In the 3D View, click each camera button to see the default cameras provided.
3. Click the Free camera button to return to the first position.

2.2.3 Zoom and Rotate the Camera with the Mouse

Mouse clicks, presses, and drags can work differently based on the settings of the camera being used, as specified in the Camera dialog box. For more information, see "6.2.3 Camera Movers" on page 94.

1. If the Camera dialog box is not open (it might be minimized), choose **Window > Camera**. (If it is minimized, maximize it.) The Camera dialog box opens (Figure 7).

Figure 7. Camera dialog box



2. In the Camera group box, select Free.
3. In the Camera Mover group box, select Fly.
4. In the 3D View, click the Free camera button.
5. Move the mouse cursor into the 3D View and press the left mouse button. The camera zooms in.
6. Press the right mouse button to zoom out.
7. Press and hold both buttons and drag to rotate the camera around the character.

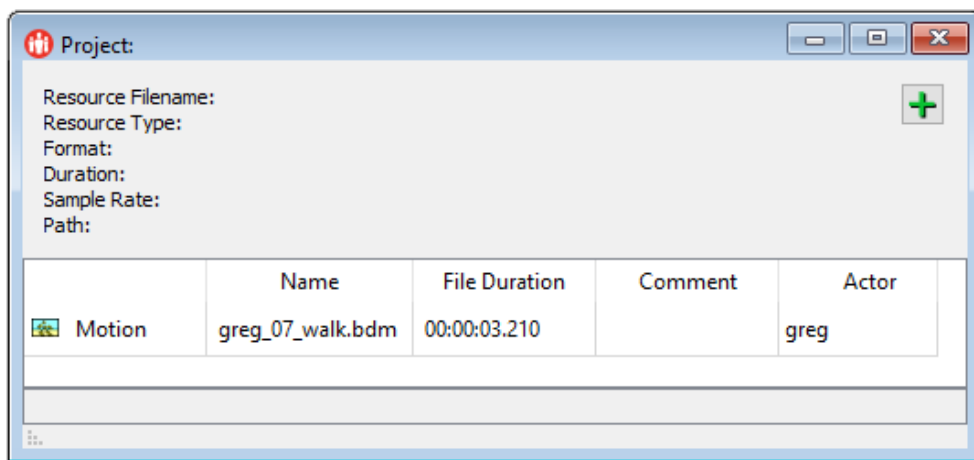
2.2.4 Load a Motion into the Project

A pose is defined as a single frame. A motion is defined as one or more frames.

1. Choose **File > Import > Motion or Pose** or click the Import Motion button (+) in the Project window.
2. Navigate to the `./motions` directory (the default).
3. Select `greg_07_walk.bdm`.
4. Click Open.

The motion file is placed in the list of assets in the Project window (Figure 8). An asset can be a motion, a pose, or an audio clip. You can drag an asset into the timeline.

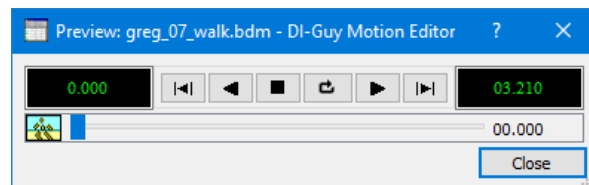
Figure 8. Updated Project window



2.2.5 Preview the Motion

1. In the Project window, right-click the motion. A menu is displayed.
2. Choose **Preview**. The Preview player opens (Figure 9).

Figure 9. Preview player



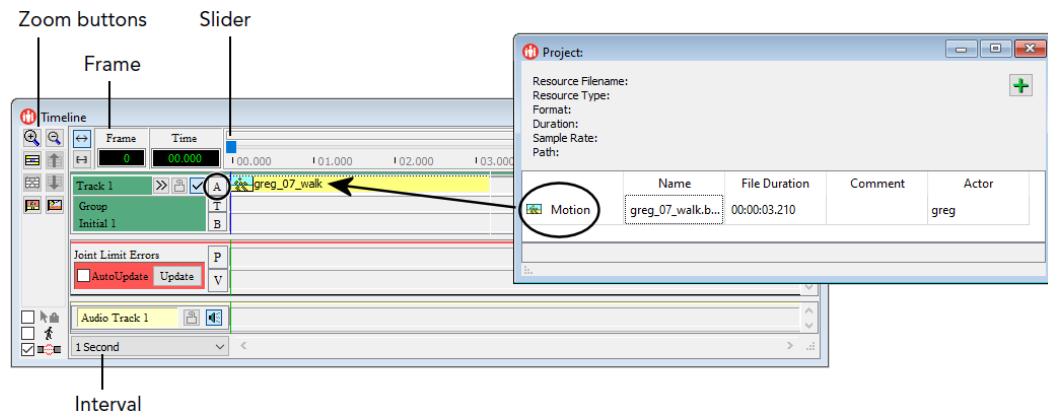
3. Click the Play button on the Preview player. The motion plays in the 3D View.
4. Close the Preview player.

2.2.6 Drag-and-Drop the Motion onto the Timeline

1. Drag the motion from the Project window onto the left end of Channel A in track 1 in the timeline (Figure 10).

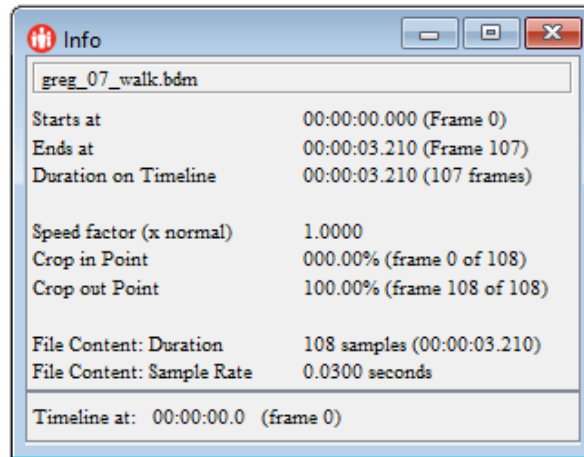
Channels A and B are designed to hold motions and poses. The T channel is for transitions. The A and B channels allow you to use overlapping motions as input. Without transition information, data in the A channel overrides data in the B channel.

Figure 10. Timeline window with motion added



2. Click the zoom buttons (on the Timeline) to increase or decrease the interval between the tick marks on the timeline. As you click the zoom buttons, the interval listed on the Interval button changes.
3. Another way to change the Timeline tick interval is to select an option on the Interval list. You can choose a tick interval in frames or in seconds.
4. The length of a frame is equal to DT (delta time). For details about setting DT, see "4.15. Setting Motion Editor DT" on page 79.
5. If the Info window is not open, choose **Windows > Info**. (If the window is minimized, maximize it.) The window is blank.
6. In the Timeline, select the motion. The Info window displays details about it (Figure 11).

Figure 11. Info window with motion selected

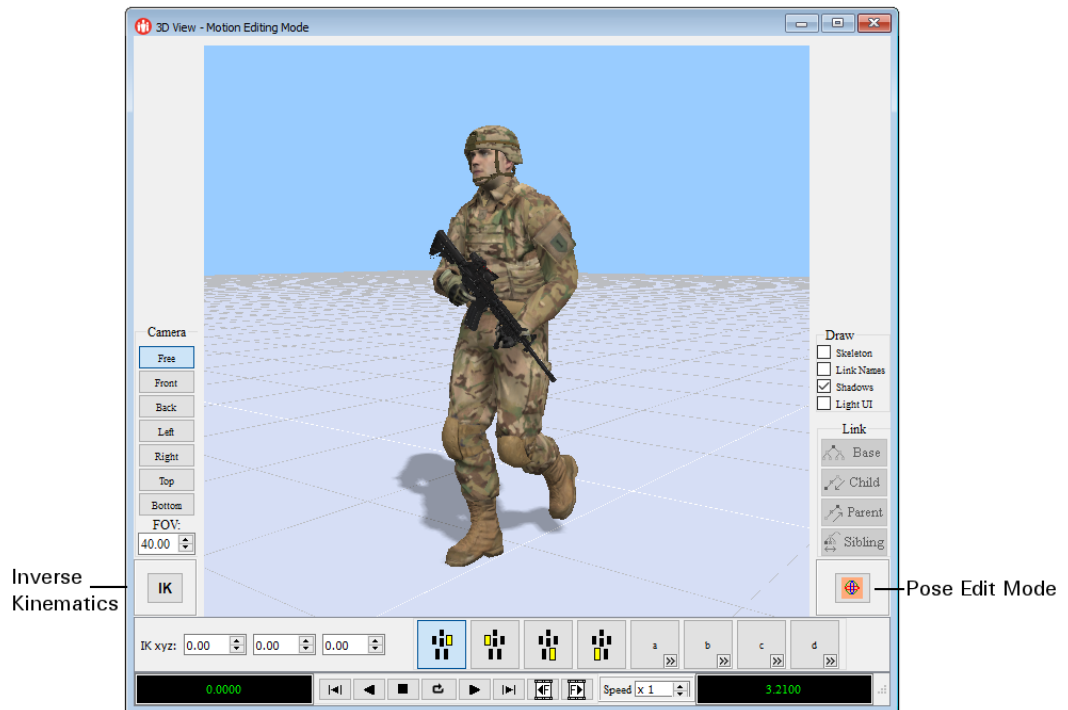


The Info window shows the position of the selected motion in the timeline (in this case, it starts at frame 0), whether it is scaled or cropped, and the original file-content duration (3.210 seconds) and sampling frequency (0.03 seconds/sample = 33.3 Hz). The last line tells where the time cursor is set in the timeline (frame 0).

2.2.7 Play the Motion

1. Click the Play button (▶) on the 3D View (Figure 12).

Figure 12. 3D View



2. Watch the soldier perform the motion.
3. Watch the time indicator on the Timeline advance.

4. Experiment with the playback controllers:
 - Click Home () to go back to the beginning of the motion.
 - Click Play () and, before the motion ends, click Stop () to stop the motion.
 - Click Cycle () to keep repeating the motion.
 - Click Play Reverse () to play the motion backwards.
 - Click Forward One Frame () to advance the motion by a single frame and Back One Frame () to reverse by a single frame.
 - Click End () to skip to the end.
5. Drag the Timeline slider (Figure 10 on page 34) back and forth and watch the motion move accordingly.
6. Click Cycle () to have playback loop repeatedly over the time range.
7. While the motion is playing, press both mouse buttons and circle the mouse to move the camera around.
8. Click each camera button in turn to see the motion from different cameras.
9. Press the right and left mouse buttons to zoom in and out.
10. Click the up and down arrows on the Speed control to speed up or slow down the motion.
11. Save the project.

2.3. Blending a Pose into the Motion

One way to create a new motion is to change an existing motion. A common technique is to modify the pose of the character somewhere during the motion and then blend that pose change with the original motion to create a final smooth motion. The new motion will look like the old motion except for the region that was blended.

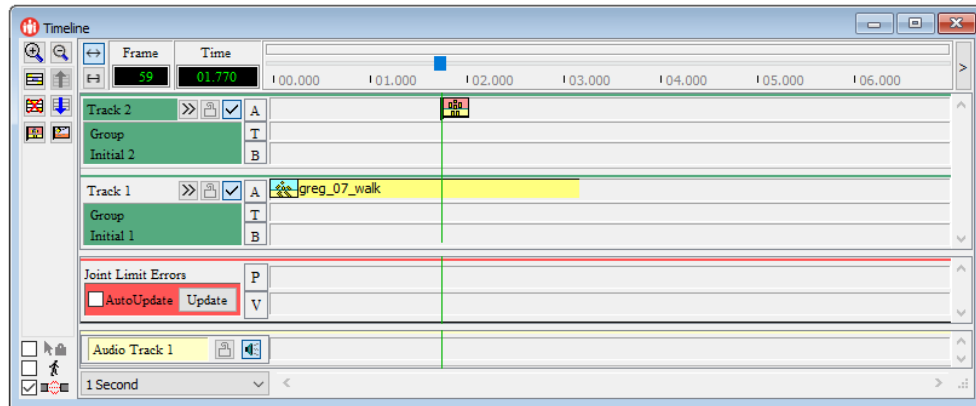
2.3.1 Extract a Pose

In this tutorial, we extract a pose from a motion and modify it so that the soldier is waving. A pose is one frame of a motion.

1. If the project from the previous tutorial is not open, open the Motion Editor and load the project.
2. In the Timeline window, drag the slider until you find a place where you want to create the modified pose. For this tutorial, we will put the wave at frame 59. The current frame is shown both on the Timeline (Figure 10 on page 34) and on the bottom line in the Info window.
3. Click the Grab Pose button () in the Timeline's toolbar.

A new motion track (Track 2) is automatically added, and the character's current pose is grabbed and displayed at frame 59 on the new track.

Figure 13. New track after grabbing pose



By default, any newly created track has all of the joints enabled. Selecting and unselecting joints is described in "Joint Group Asset" on page 65. The track's Joint Group Asset determines which joints are controlled (enabled) by a track.

The newly created pose is not a project asset in this case (notice that it is not shown in the Project window – only the original motion is shown), because it exists only internally to the project that is currently being worked on and has not been saved. It is called a runtime pose.

Poses contain a single, static snap-shot of every joint value (the position of a joint) for all joints of the current Motion Editor character.

2.3.2 Edit the Pose

A character is made up of body parts connected at joints. The arrangement of the joints results in a pose. This section shows how to edit the pose of a Motion Editor character using inverse kinematics, the poser, and the Joint Editor.

Modify a Pose using Inverse Kinematics (IK)

Inverse kinematics uses kinematic equations to determine possible joint values that satisfy a desired position and orientation for the end effector (or the last link) of a joint-link assembly.

1. Choose **Window > Joint Editor**. The Joint Editor opens (Figure 18). It displays the DOF value for each joint in the current pose.
2. In the 3D View, click the Left camera button so that the soldier's left arm is visible. If necessary, center the character in the 3D View.
3. Click the IK button (below the camera buttons).
4. Click the left arm IK button (⌘). (The IK buttons are oriented for the character's left and right sides, not viewer left and right. If you are unsure, look at the tooltip.)

The character's left arm should highlight and an IK cursor (green and red cross marks) should display. Other IK buttons activate other pre-defined body limbs of the character.

Figure 14. The Left camera is selected and IK is editing the left arm



5. Click and drag the mouse so that the left hand (which tugs on the left arm) is in an up position. Several of the values in the pose being edited will change. Notice that the corresponding values for those joints in the Joint Editor window also change as the mouse is moved. These values are stored in the pose on the timeline each time the mouse moves.

Figure 15. Left arm raised



You have now used inverse kinematics to alter the pose of a character. In this example, the hand was the end effector and the joint-link assembly (or chain) was the left arm.

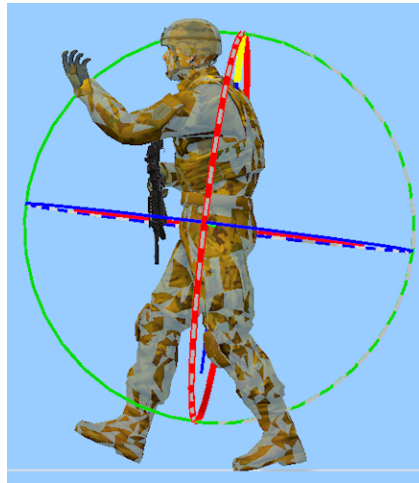
6. Click the IK button to exit IK mode.
7. Save the project.

Modify the Pose Using the Pose Tool

The Pose tool lets you move a joint in three dimensions.

1. In the 3D View, click the Pose Edit button (🌐). The entire character is highlighted with the posing gizmo located at the character's base (Figure 16).

Figure 16. Pose Edit mode



2. Click the Free camera button.
3. Press **Alt** and use the mouse to move the camera. (In Pose Edit mode, you must press **Alt** to move the camera.)
4. Locate the Pose Tool's gizmo on the left shoulder. Do one of the following:
 - **Shift**+left-click on the left arm.
 - Use the poser navigator buttons to move the gizmo through the character's joint space (which can be slow, but more precise).

Figure 17. Gizmo on shoulder



5. When the poser gizmo is located at the joint, you can edit the joint. To do so, you select a circle and move the joint around the axis. Each circle represents the joint's degrees of freedom, or DOF. The x-axis DOF is red, y-axis DOF is green, and the Z-axis DOF is blue. To select an axis, do one of the following:
 - Press the space bar.
 - **Shift**+left-click the different circles.
6. Move the joint around the selected axis. To move the joint, do one of the following:
 - Using the mouse, drag the highlighted circle.
 - Press **+** or **-**. Hold down **Shift** to increase the amount of change for each key press.

The new values are stored inside the pose being edited.

7. Save the project.

You have now successfully altered the character's pose using the Pose Tool.

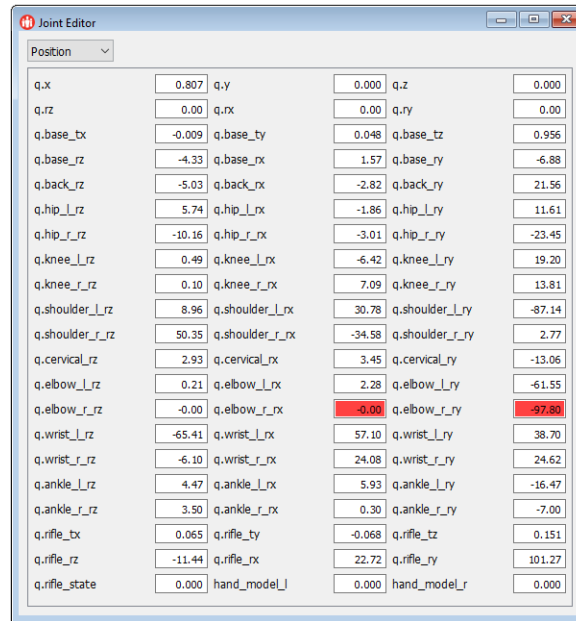
Modify the Pose Using the Joint Editor

The Joint Editor allows you to directly review and change the values of all the DOFs of a character as specified by the timeline at the current time. You can also edit joints in the Outliner. (For information about the Outliner, see "5.1.2 The Outliner" on page 85.)

1. Choose **Window > Joint Editor**. The Joint Editor opens (Figure 18). It displays the DOF value for each joint in the current pose.

When the list in the upper left corner of the window lists Position, it means that the joint values are displayed. Joint variable names that end with tx, ty, or tz indicate translation in meters along the local X, Y, and Z axes. The base joint of all characters contains these variables. Joint variable names ending with rx, ry, and rz indicate rotation in degrees about the X, Y, and Z axes.

Figure 18. Joint Editor



2. In the 3D View, run the motion. Notice how the DOF values in the Joint Editor boxes change as the character moves.
3. You can edit a pose by manually changing the DOF values in the Joint Editor. Since we have been working on shoulder values in this tutorial, try this:
 - a. Find the DOF **q.shoulder_l_rx**.
 - b. Type a new value. Make it a large change. For example, if the current value is 18.xx, change it to 48.xx.
 - c. Press **Enter** or **Tab**. The joint moves to the new pose.

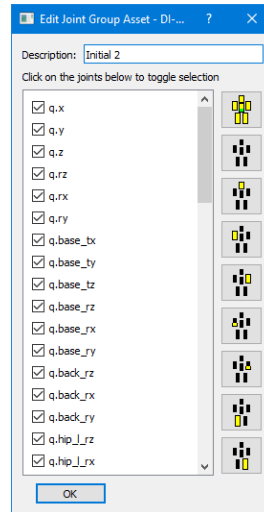
Changes to DOFs in the Joint Editor are stored in the active pose, so it is important to notice which motion track is active and where the time cursor is, as that determines which pose will be changed.

2.3.3 Blend the Pose into the Motion

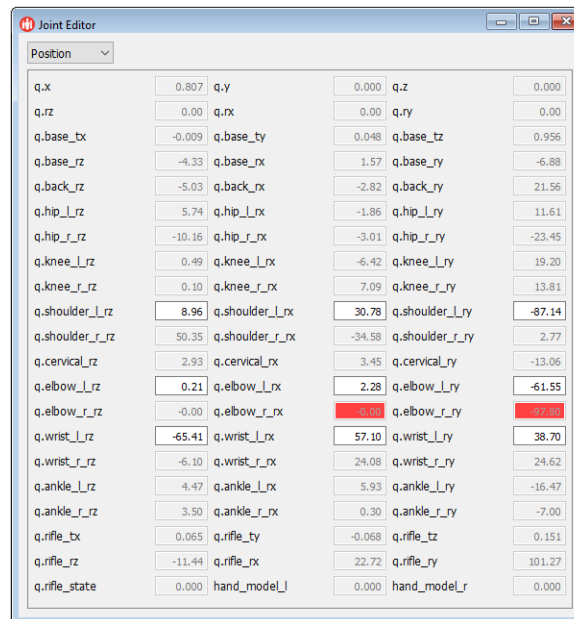
When a motion plays on the timeline, the new pose has no effect, except on frame 59. That is because, for every frame, the timeline gets the data from the greg_07_walk motion, except on frame 59 where it gets the data from the new pose.

We need to blend our new pose into the walk motion. After the blend, the effects of the pose will be spread out across several frames, resulting in a smooth, natural appearing motion. We will have Track 1 control all the joints and have Track 2 control only the left arm. Track 1 already controls all joints, so there is nothing to change on Track 1.

1. Click the Track Popup Menu button (⌵) on Track 2 or right-click the larger green square of Track 2 (with the text Group in it). A menu displays.
2. Choose **Joint Group Asset**. The Edit Joint Group Asset dialog box opens (Figure 19).

Figure 19. Edit Joint Group Asset dialog box

3. Click the Clear All button (🗑️) to turn off all the DOFs. (The buttons on the right-hand side of the dialog allow you to toggle pre-defined DOF groups on and off.)
4. Click the IK Left Arm button (👤) to select the left arm joints.
5. In the Description text box, change the name to Left Arm.
6. Click OK. The Joint Edit window now has many joint values that are not available.

Figure 20. Joint Editor with left arm joints active

7. Click greg_07_walk in the A channel of Track 1 to make it active.
8. Copy greg_07_walk.
9. Paste it to the B channel of Track 2.

10. Drag a Teepee blend (Figure 21) from the Transition toolbar into channel T (Transition) of Track 2. Place it in a position where it is centered directly underneath the pose (Figure 22).

Figure 21. Transition toolbar, Teepee blend

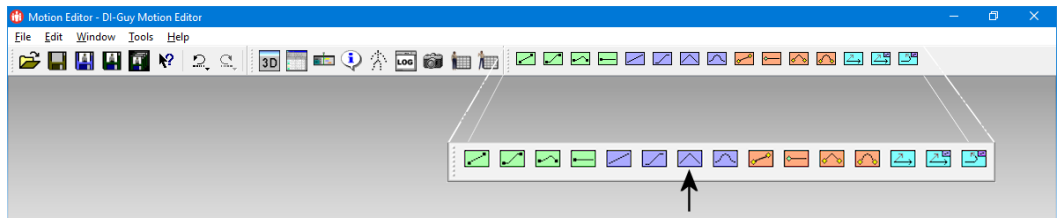
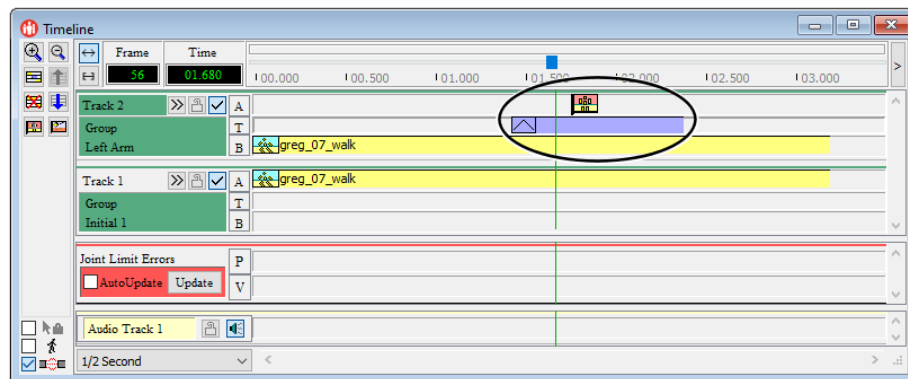


Figure 22. Teepee blend added to timeline



11. Play the motion. See how the character moves its arm as it approaches and passes frame 59. It will probably move its arm very quickly. You can adjust the blend to change the timing of the arm movement.
12. Hover the mouse over one end of the purple blend area. It changes to a double arrow. Drag the end of the blend to make it longer.
13. Play the motion again. See that the arm motion takes more time than the first time. If you want to, experiment with changing the blend length before and after frame 59.

You have now created a waving motion built on top of the original greg_07_walk. Later, you will learn how to save this motion and incorporate it into the Action Table.

14. In the Timeline, click the Track Playback button (☒) for Track 2 to disable playback.
15. Play the motion. Only Track one plays, so the arm does not move.
16. Enable Track 2.
17. Save the project.

2.4. Undo

The Motion Editor includes undo and redo functions. Most functions including loading, moving, and editing can be undone and redone.

The Motion Editor maintains a list of recent actions that you have done or undone. If you undo an action that is not at the top of the history list, all actions that were performed after the selected action are also undone.

- ▶ To immediately undo or redo the action at the top of the history list, choose **Edit > Undo** (or **Redo**). The Motion Editor redraws itself.
- ▶ To select an action to be undone or redone:
 1. Click the Undo button () or Redo button () on the Motion Editor toolbar. The history list displays.
 2. Select the action to be undone or redone.

2.5. Cut, Copy, Delete, Paste

Cut, copy, paste, delete, and edit functions are usually available for any asset placed in the timeline. For example, in the previous tutorials, the motion file we added and the pose we created are assets.

- ▶ To cut, copy, or delete an asset:
 1. In the Timeline, select the asset.
 2. Choose **Edit > operation**, or right-click the asset and choose the edit action from the context menu.
- ▶ To paste an asset, right-click the track and destination channel for the paste and choose **Paste** from the context menu.

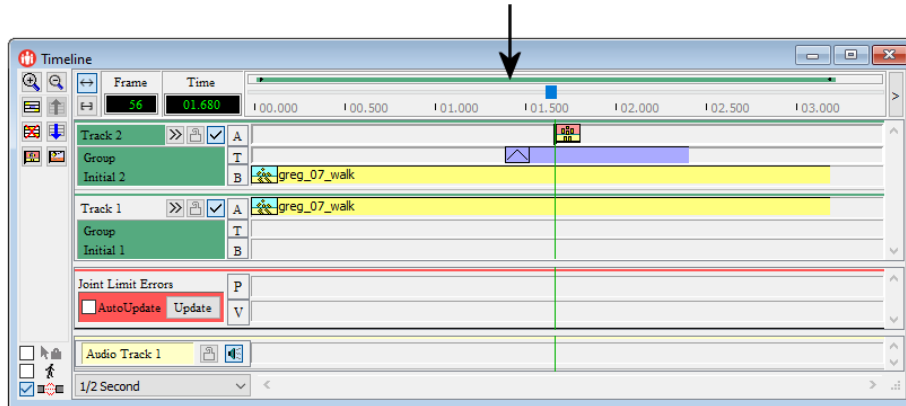
Selecting Edit brings up a dialog box that allows direct modification of values.

2.6. Export a Motion from the Timeline

We will now export the motion from the Timeline. DI-Guy uses a convention for a cycle of walking that starts and ends the loop when the right foot passes the left. For our motion, the walk loop starts at frame 34 and ends at frame 86. The Range Selector at the top of the Timeline is used to define non-default start and stop times for a motion.

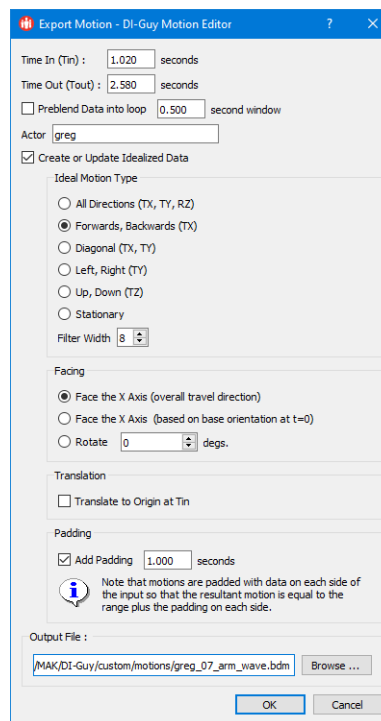
1. Double-click the horizontal bar above the Timeline slider. The range selector changes to input mode. It is now green with arrows at each end (Figure 23).

Figure 23. The Range Selector



2. Drag each end of the range selector: one to frame 34 and one to frame 86.
3. Play the motion in the 3D View. It plays only the selected region of the timeline.
4. Choose **File > Export > Motion** or click the Export Motion button at the top right of the Timeline window (>). The Export Motion dialog box opens (Figure 24).

Figure 24. Export Motion dialog box



5. Accept the defaults that the system calculates for Time In, Time Out, and Idealized data. (See "9.4.1 Creating or Updating Idealized Data" on page 136 to learn about those options.)

6. Click Browse. The Specify An Output Filename dialog box opens. The default directory is `./custom/motions`. By exporting the file to a custom directory, there is no risk of overwriting the original motion data file, while also making the changes more portable to other systems.
7. Use the default name for the motion: `greg_07_walk`.
8. Click Save.
9. In the Export Motion dialog box, click OK. The Preview dialog box opens.
10. Click the Play button. The motion displays in the 3D View.
11. Close the Preview dialog box. The Make Motion Available in the Following Action Table dialog box opens.
12. Click OK. The Motion Editor dialog box opens. It prompts you to enter a name for the motion.
(If you click Cancel, the motion simply is not stored in an action table. The file was already saved and exists in the directory you specified.)
13. Accept the default or type a new name and then click OK.
14. The new motion should now be part of the action table.
When the Motion Editor asks to update T-in and T-out for motion arc `greg_07_walk`, answer Yes. The Motion Editor will ask for the name of the motion arc using this motion.
15. Accept the default for this example so that the file will be found and reloaded. Motion arc `greg_07_walk` is used by the walk action in the Action Table.

2.6.1 Test the Results

► To try out the new motion from the Action Table:

1. Choose **Window > Action Table**. The Action Table Editor opens (Figure 3 on page 29).
2. Select the Actions tab.
3. In the Action List, double-click walk. The soldier starts walking, and you should see him wave. This allows you to demo the new motion and motion transitions before exporting them to DI-Guy.

 This modified motion arc and action table are not saved as part of DI-Guy unless you choose **File > Save Action Table**. Delete motions, such as `greg_07_arm_wave.bdm`, from the `./custom/motions` directory to return to the default DI-Guy functionality.



3. The 3D View

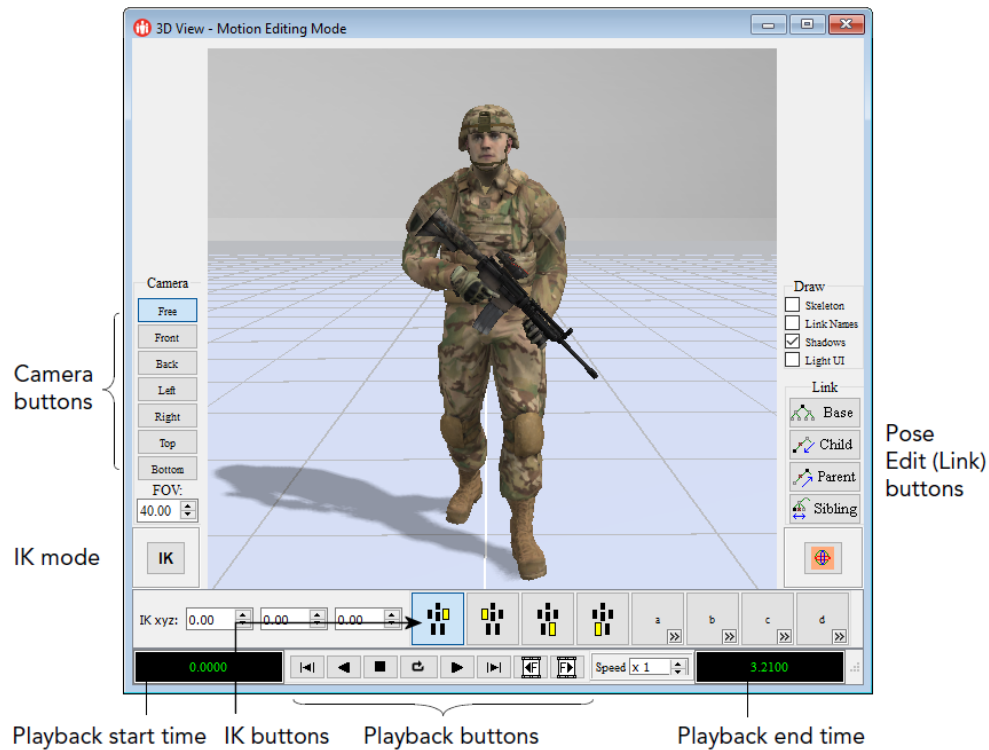
This chapter explains how to use the features of the 3D View.

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3.1. Opening the 3D View

The 3D View provides a 3D display of the character and lets you view motions and poses.

Figure 25. 3D View



The camera lets you move the viewpoint in 3D space so that you can examine characters from any angle.

You can dynamically change a character's pose in two ways:

- Inverse Kinematics (IK) mode. In IK mode, mouse movements manipulate the end effector.
- Pose Edit mode. In Pose Edit mode, mouse movements increment or decrement a DOF (degree-of-freedom).

You can control playback of the data shown in the Timeline window by using the playback controller at the bottom of the 3D View.

i When you are in IK mode or Pose Edit mode, you must press and hold **ALT** to go into camera mode.

➤ To open the 3D View, choose **Window > 3D**.

3.1.1 DI-Guy Space

The Motion Editor exists in Cartesian space with an X-forward, Y-left, and Z-up coordinate system. The 3D View of a scenario displays a grid as a visual aid to show the XY plane. The origin of the world is in the middle of the grid. All distances reported or entered in DI-Guy are measured relative to the origin. DI-Guy characters walk forward along the X-axis by default.

Figure 26. DI-Guy Space

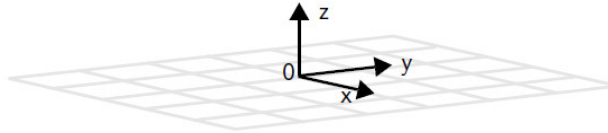
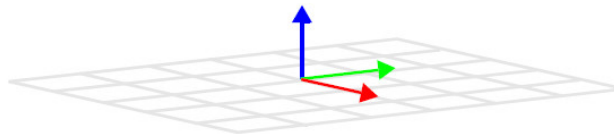


Figure 27. Motion Editor coordinate system orientation



3.1.2 Moving the Camera

The camera buttons located in the 3D View (Figure 25 on the previous page) allow you to quickly change the camera settings, and thus the view in the 3D View. If you change the camera by rotating or translating the camera position using the mouse, these new settings become associated with the active camera button. Therefore, the names Front, Left, and so on, are descriptive of the original settings of these buttons only.

Reset the view as desired using the Camera dialog box, or delete or rename any cameras and change all of its settings. The names shown have defaults so that if you create a camera with any of these names and press the Reset button, they take on the preset configuration values.

The set of all defined cameras can also be quickly swapped out with a customized set of user-defined cameras. For more information about camera settings, see "6.3. Changing the Camera Settings" on page 98.

3.1.3 Playback Controller

The Playback Controller, allows you to play motions and see them in the 3D View. It has eight buttons that allow control of playback. They are:

- Rewind to the beginning. Make the current time be the earliest time as specified by the Range Selector.
- Play backwards. Play the motion backwards.
- Stop. Stop playing the motion.
- Cycle/Loop. Toggle the cycle state. When cycle is active, the playback controller continuously loops through the motion.

- Play. Play the motion.
- End. Make the current time be the last time on the timeline with data, or the last time on the Range Selector (when it is displayed).
- Frame Backward. Move back one frame. Hold the button down to continuously move frame-by-frame.
- Frame Forward. Move forward one frame. Hold the button down to continuously move frame-by-frame.
- Speed. Specify the playback speed relative to real time.

The playback area also displays the start and end times:

- The left counter shows time at the start of the simulation data file (usually zero).
- The right counter shows the time extent at the end of the timeline, regardless of the Range Selector. This is the last piece of data on any frame.

3.2. Pose Edit Mode

This section describes how to select joints and DOFs. For more detailed information about all joint names, link names, and DOF, see "5.3. Joints and Links" on page 87.

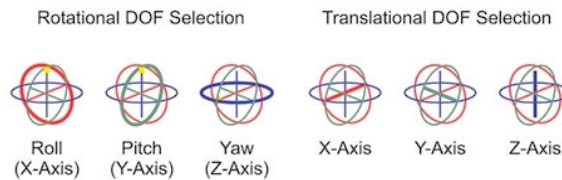
► To edit a pose:

1. Click the Posing Tool button (). The poser gizmo is displayed (Figure 28 on the facing page).
2. Use the mouse to select and adjust a joint and a DOF.

3.2.1 The Six Degrees-of-Freedom of the Poser Gizmo

By default, the posing tool selects the base joint of the character. The gizmo draws six graphic handles (three translation posts and three rotation circles) associated with the six DOFs of the base. On a human, this base joint is at the hips.

- Adjust the values of the DOFs of the joint by clicking and dragging on a graphic handle, constrained by the DOF's range of motion.

Figure 28. Poser gizmo with base link selected**Figure 29. Poser Gizmo graphic handles for the 6 basic degrees-of-freedom**

Three translational posts let you move the object linearly along an axis and use a length value:

- Front and Back, Red, adjusts along the X axis.
- Side to Side, Green, adjusts along the Y axis.
- Up and Down, Blue, adjusts along the Z axis.

Three rotational circles let you adjust the joints rotationally and use an angular value:

- Blue circle adjusts the yaw (around the local Z axis).
- Red circle adjusts the roll (around the local X axis).
- Green circle adjusts the pitch (around the local Y axis).

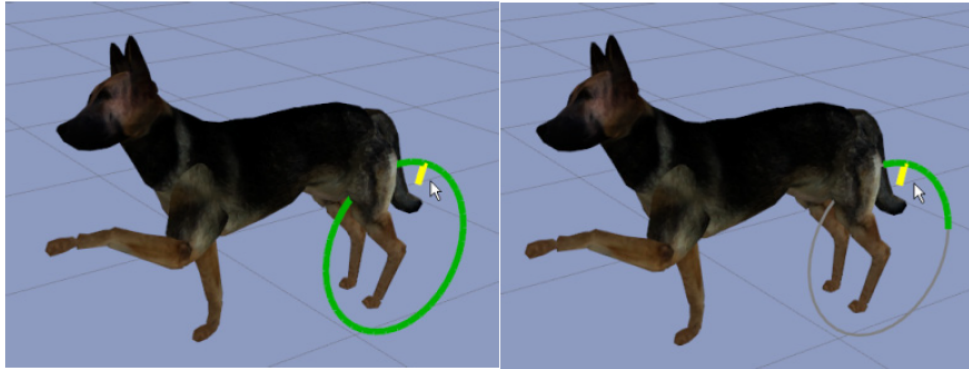
DI-Guy uses a ZXY rotation order.

The Poser Gizmo and Non-6DOF Joints

The poser gizmo only draws graphic handles for DOFs available in a joint. The majority of joints in DI-Guy characters are 3DOF rotations, so no post handles are drawn. Pin joints only have a single circle. For example, Figure 30 shows the poser widget for a dog's left ankle, which uses a pin joint. The name of the DOF being edited is **q.b_l_ankle_ry**. The **_ry**

implies rotation about the local Y axis, which is drawn using a green circular handle. Only the portion of the handle that is valid is drawn. The right image shows a grayed-out part of the handle that is off-limits.

Figure 30. Poser widget for 1 DOF joint. Left: without limits, Right: with limits



1. Click the Posing Tool button (🌐). By default the base joint is selected.
2. Select a DOF by **Shift**-clicking a graphic handle or press the **Spacebar** to select DOFs sequentially.
3. Adjust the joint by dragging the mouse or using the **+** or **-** keys (optionally holding **Shift** down to increase the change).
4. Continue selecting joints and adjusting them until the desired pose is achieved.

3.2.2 Changing the Camera while Using the Posing Tool

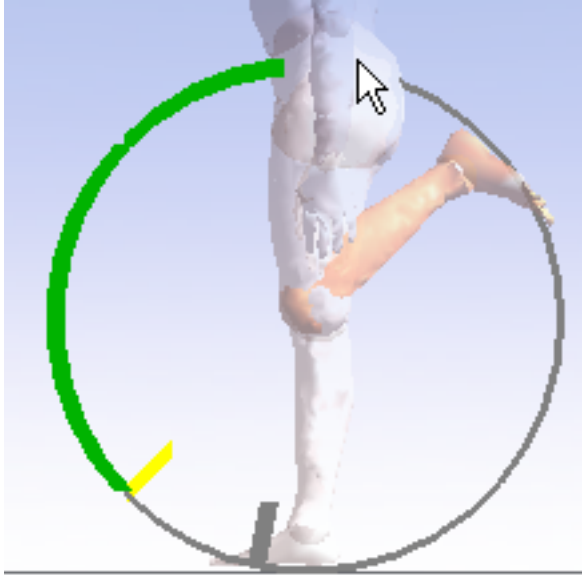
It is often useful to move rapidly between camera adjustments and posing tool adjustments.

Press and hold **Alt** to temporarily turn off the posing tool and allow you to adjust the camera.

With the posing tool on, moving the mouse adjusts joints and does not affect the camera, unless you press **Alt**.

3.2.3 Selecting a Joint

When you select a link, the link's proximal joint is activated for adjustment. The joint and all distal links (links further from the body) are highlighted. Each of the available DOF is shown with a graphic handle. Figure 31 shows a knee joint.

Figure 31. Knee joint

You can select a joint in the following ways:

- **Shift**-click a link distal to the desired joint.
- Click a joint navigation button (buttons are disabled when inapplicable):
 - Base button. Selects the base joint.
 - Child button. Selects the first child joint of the current joint.
 - Parent button. Selects the parent joint of the current joint.
 - Sibling button. Cycles through sibling joints of the current joint.
- Press a posing tool hot key:
 - Up arrow. Selects the parent joint of the current joint.
 - Down arrow. Selects the child joint of the current joint.
 - Right arrow. Cycles through the sibling joint of the current joint, starting to the left and wrapping if needed.
 - Left arrow. Cycles through the sibling joint of the current joint, starting to the right and wrapping if needed.

Joint limits are not specifically set in DI-Guy Motion Editor. You can set joint rotational limits in the Joint Limits dialog box. (For details, see "Setting Joint Limits".) In Figure 31:

- The knee joint is activated for adjustment.
- The lower leg link and the foot link are highlighted.
- The knee joint has one DOF shown with a green graphic handle.
- The circle indicates that this is a rotational DOF.
- The green color shows that the pitch (around the X axis) is active.
- The highlighted arc (in green) shows the range of motion of the knee joint.

- The yellow marker shows the current angle of the calf.
- The gray marker shows the location of the cursor and that it is out of the knee's range of motion.

Sometimes, due to the graphic display or obstruction, you may have trouble clicking a desired body part to select a joint for pose adjustment. The joint navigation buttons allow you to navigate through the hierarchy of joints by ascending or descending chains of joints or by choosing parallel chains.

3.3. Selecting a DOF

If a joint has a single DOF, it is automatically selected when the joint is selected. If a joint has more than a single DOF, one is selected by default.

- To select a different DOF, **Shift**+click the graphic handle of another DOF.
- Press the **Spacebar** to cycle through the DOF on the selected joint.

3.4. Adjusting a Joint

You can edit each joint by at least one DOF. With a joint and a DOF selected, you can adjust the joint by dragging the mouse or using Posing Tool hot keys, as follows:

- **+**. Increase rotation or translation value. Press **Shift** to increase the movement.
- **-**. Decrease rotation or translation value. Press **Shift** to increase the movement.

3.5. Inverse Kinematics Mode

Kinematics is the term used to describe the mathematical operations that allow you to determine the exact position and orientation of the end link of a multi-joint linkage from the start position and orientation of the base link and the state of each DOF in the linkage. The mathematics of kinematics, when used in this sense, is a deterministic operation. That is, for a set of given input parameters, there is only one answer to the problem.

Inverse kinematics is the term used to describe the opposite mathematical operation, when you know the desired position and (possibly) orientation of the end link of a multi-joint-linkage, and you would like to determine the state of each DOF in the linkage that would allow the linkage to reach this desired goal. Unlike kinematics, this mathematical operation is non-deterministic. That is, there may zero, one, or multiple different input parameters that would achieve the desired goal position and orientation. This is because the operation is inherently under-constrained – there will almost always be more than one solution to the mathematical equations.

What is important, is that inverse kinematics allows you to grab the end of an arm or a leg of a character and drag it to a new position, and the Motion Editor will automatically try to guess all of the intermediate joint values.

i Because IK is inherently under-constrained, it can sometimes behave strangely. If the joints in a chain each have only a single degree of freedom (1DOF), it is easier to produce good results. Chains with joints having 2DOF or 3DOF make IK very challenging. You may see poor results in those cases. Use the Pose Tool, Joint Editor, or Outliner instead.

3.5.1 Performing Inverse Kinematics

► **To use inverse kinematics:**

1. Click the IK button to enter Inverse Kinematics mode.
2. Select one of the eight IK buttons at the bottom of the 3D View to be the IK chain.
3. In the 3D View, click a point on or near the end effector of the joint assembly, and drag it.

When the mouse is released, the resulting pose is saved in the Timeline as a runtime pose. If there is a runtime pose in the active track on the Timeline at the current frame, the result overwrites the pose. If there is not a runtime pose in the active track, a runtime pose is automatically generated to receive the new settings.

- i**
- Unanticipated behavior can result if the active track does not have highest level control in the Timeline for all of the DOFs being modified by IK. This can occur if a track of higher priority also controls one or more of these DOFs. In addition, unexpected behavior can result if a runtime pose is masked by a transition.
 - Press and hold **F1** to reduce mouse movement sensitivity.
 - To enter camera mode while doing IK, press and hold **Alt**.

The eight buttons below the 3D View (Figure 25 on page 48) contain four pre-configured Joint Group Assets (with icons indicating the factory settings) and four (potentially blank) Joint Group Assets initially labeled a through d. The four buttons with icons work for most human characters, but they do not work well for animals or vehicles.

3.5.2 IK Configuration Buttons

The Motion Editor has four pre-defined IK configurations. The arm configurations (two left-most buttons) allow the orientation of the end effector (the hands) to vary. The leg configurations (buttons 3 and 4 from the left) expressly preserve the orientation of the end effector (the feet).

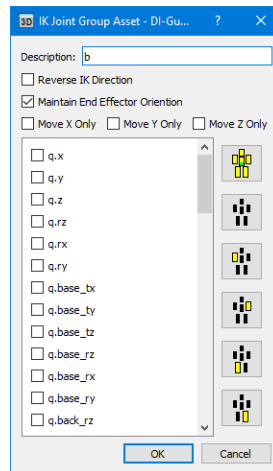
3.5.3 User-Defined IK Buttons

You can specify IK configurations using the a, b, c, and d IK selection buttons, which can also be renamed to something more descriptive.

► To configure a user-defined IK setting:

1. Click the tiny button (>>) in the lower right corner of the IK button and select Joint Group Asset, or right-click the IK button. The IK Joint Group Asset dialog box opens (Figure 32).

Figure 32. IK Joint Group Asset dialog box



2. In the Description box, type a name for the button. It gets displayed on the button, so keep it short.
3. Optionally, select Reverse IK Direction. Instead of a normal IK operation where the inbound part of the IK chain is fixed and the outbound end is to be manipulated, the outbound end is fixed and the inbound end and base joint are manipulated. Reverse inverse kinematics is particularly useful if you have a hand or foot positioned on a desirable location, but would like the rest of the body to move during IK. A typical example is to set up a track that either controls the two legs (or the two arms), and where the two feet (or two hands) are already positioned at a desired position and orientation. Reverse IK mode will let you manipulate the body while preserving the feet (hands) position.
4. Optionally, select Maintain End Effector Orientation. This specifies whether or not IK edits allow the orientation of the end-effector (the last joint in the chain) to vary.
5. Select Move X Only, Move Y Only, or Move Z Only. This specifies whether or not IK edits restrict the mouse-driven inputs to the IK solver to vary only in certain axial directions. These three check boxes are mutually exclusive. For example, if Move Z Only is selected, then when you use the mouse in the 3D View while in IK mode, the software ignores the X and Y axis related movements of the mouse, and only considers the Z axis mouse movement. This could be useful if you are trying to raise the end of a chain without moving it left or right.
6. In the list of joints, select the active joints for the joint group.

3.5.4 Trajectory and Trajectory Atoms

There are four ways to perform IK on a motion track. It can use either the familiar motions and poses that other transitions use (for example, when using the IK Teepee blend () and IK Igloo blend ()), or it can use trajectories and atoms (for example,

when using IK Linear Interpolation () and IK Hold () transitions). These latter two transition types are described in this section, since they use a unique object on the Timeline called a trajectory.

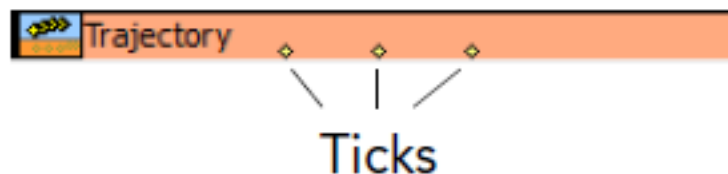
A trajectory is composed of one or more trajectory atoms (). Atoms act as IK goal data for IK and contain the three rotation values (rz, rx, and ry) and three position values (X, Y, Z). For example, if the motion track has only the left arm enabled, then the end effector would be the tip of the left hand. In 3D space, the hand can be described using six values – its position (X, Y, Z) and its orientation (yaw = rz, roll = rx, and pitch = ry).

You can create an atom using the Grab Trajectory button () on the Timeline. When an atom is grabbed, its six values are taken by inspecting the joint group asset of the active track, computing the location and orientation of the end effector in space, and storing these six values, plus the frame number, in the trajectory.

These values can be inspected and hand-edited by right-clicking on the trajectory. When the trajectory is edited, a dialog box opens that lists all of the trajectories atoms in a table.

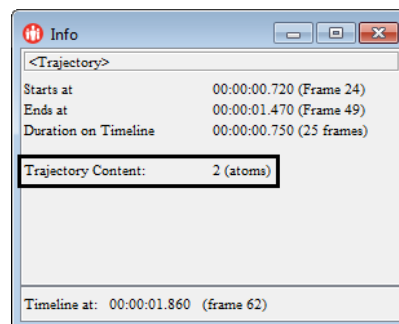
There are three different ways that you can tell how many atoms a trajectory contains. The simplest way is to look at the trajectory on the Timeline. When a trajectory has more than two atoms, you will see atom ticks lining the bottom of the trajectory indicating what frame the atom occupies (Figure 33).

Figure 33. Trajectory containing atoms



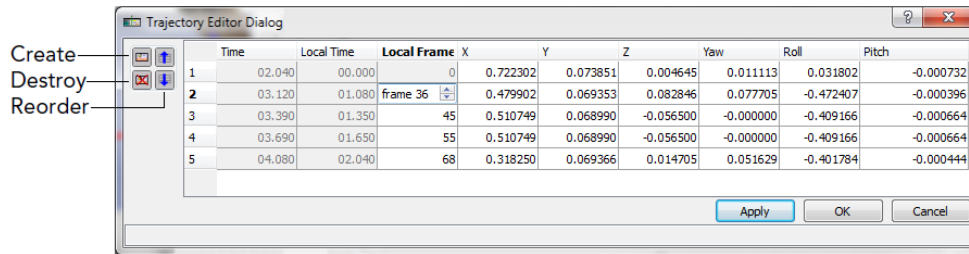
The second way to know how many atoms a trajectory has is to click on the trajectory in the timeline, and then inspect the Info window.

Figure 34. Info window with atom count



The third and last way to tell how many atoms a trajectory has is to manually edit the trajectory. You can launch the Trajectory Editor by right-clicking on a trajectory (Figure 35).

Figure 35. Trajectory Editor



The Trajectory Editor allows atom-by-atom editing, the creation of new atoms, the destruction of existing atoms, and the reordering of atoms. Each row holds the information for a single atom, starting with the first column (Time) through the last column (Pitch). For convenience, the time is shown both in global timeline time and local trajectory time, and the frame is shown in the local trajectory timescape. The last six columns hold the six values for the end-effector of the motion track's joint group asset.

3.5.5 Issuing Warnings for Out-of-Reach IK Trajectory Goals

It is sometimes useful to know whether trajectory goals are reachable. DI-Guy Motion Editor can show warnings indicating whether a simple test has shown that the desired goal trajectory point is reachable. The lack of an error does not mean that the desired goal trajectory is reachable, as the reachability test is limited and does not take into account joint limits and more complex aspects of inverse kinematics.

- To have DI-Guy Motion Editor issue warnings for out-of-reach IK trajectories, choose **File > Preferences > Issue Warnings for Out-of-Reach IK Trajectories**.

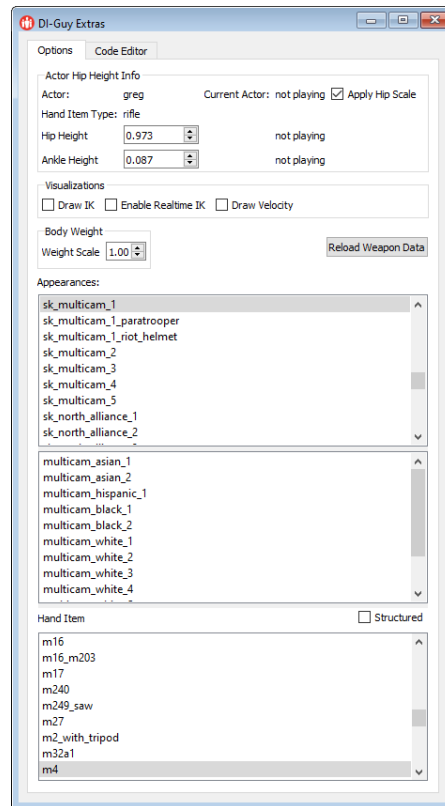
3.6. Changing Appearances

When you start a project, you select a character and an appearance. You can change appearances and hand items while you are working on a character to test its motions and IK.

► **To change appearances and hand items:**

1. Choose **Tools > DI-Guy Extras**. The DI-Guy Extras window opens (Figure 36).

Figure 36. DI-Guy Extras window



2. Select appearances and hand items in the Appearances lists.

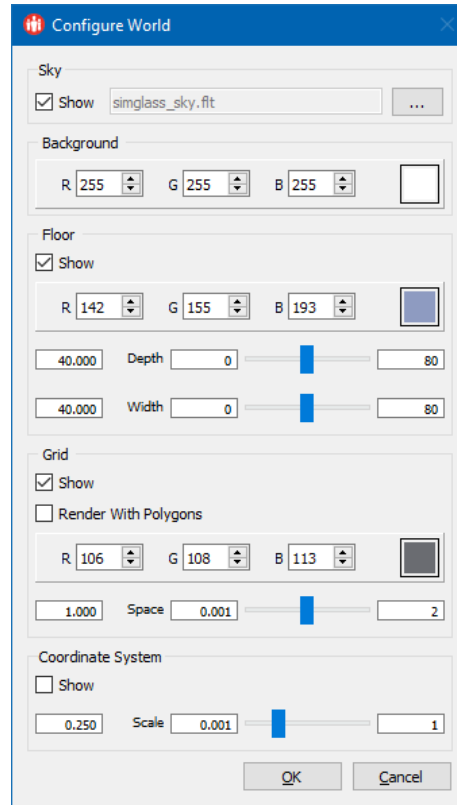
3.7. Configuring the 3D View

You can configure how the 3D world in the 3D View is displayed. You can enable and disable the sky, floor, grid, and coordinate system. You can set the colors used for the background, floor, and grid.

► **To configure the 3D View:**

1. Choose **File > Preferences > Configure World**. The Configure World dialog box opens (Figure 37).

Figure 37. Configure World dialog box



2. To enable or disable the sky, floor, grid lines, or coordinate system, select or clear the Show check box in their respective group boxes.
3. To change the color used for the background, floor, or grid lines, change the RGB values in their group boxes or click the color swatch and choose a new color.
4. To change the OpenFlight file used for the sky, click the Browse button and select a file.
5. To change the depth and width of the floor, drag the Depth or Width slider to the left or right. The value at the far left shows how many grid units are displayed. The numbers to either side of the slider show the range of the slider in grid units.

If you change the maximum or minimum range value, press **Enter** to put it into effect.

6. To change the scale of the coordinate system, drag the slider to the left or right. The value at the far left shows the scale in grid units. The numbers to either side of the slider show the range of the slider in grid units.

If you change the maximum or minimum range value, press **Enter** to put it into effect.



4. Using the Timeline

This chapter describes how to use the Timeline to edit motions.

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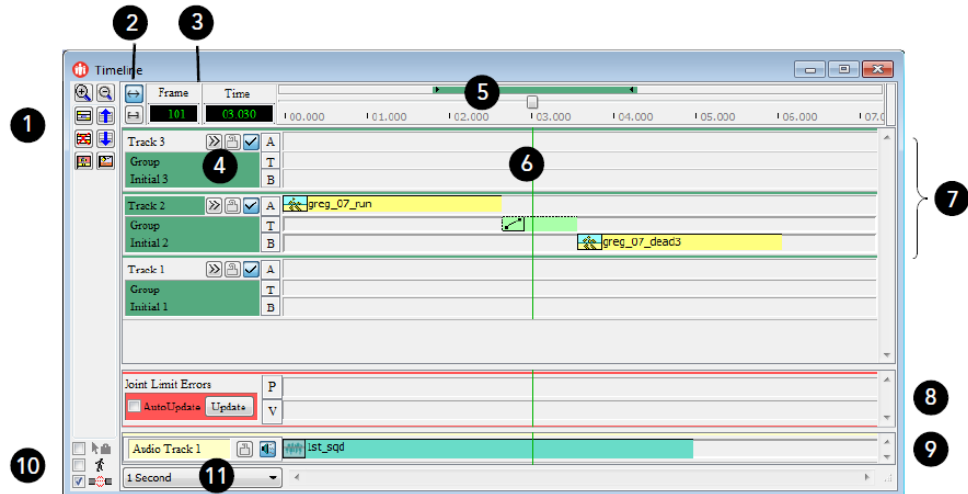
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4.1. Introduction to the Timeline

The Timeline is the heart of the Motion Editing system.

The Timeline shows the current state of the motion being generated. To construct a motion, you organize motions, poses, trajectories, and transitions on one or more motion tracks. Motions for different parts of the body can be organized using separate tracks. Figure 38 shows a Timeline with several tracks. The features indicated by callouts are described in the following paragraphs.

Figure 38. Timeline



- Timeline buttons (1). Let you zoom the timeline, add a motion track, delete a motion track, and move a motion track.
- Mouse mode buttons (2). Let you to select between stretch and crop mode when dragging the ends of motions or transition in the Timeline.
- Track buttons (4).
- Range selector (5). The range selector sets the start and end playback time.
- Time cursor (6). The green line indicates the currently playing frame and time. The time is indicated along the top of the timeline and in the frame and time displays (3).
- Motion tracks, in order of priority, top to bottom (7).
Each motion track contains an A, B, and T channel. The A and B channels typically hold raw motion or pose information, while the T channel is used for transition information (for example, blend, interpolation, and so on). There is no difference between the A and B channels, other than if data exists on both channels, the A channel data is used in the absence of transition data.
- Joint Limits Error track (8). Detects position and velocity errors for the DOF of the model.
- Audio track (9).

- Option check boxes (10). Let you turn on locking, forward travel mode, and snap-to functionality.
- Time Increment (11). Indicates the amount of time between each frame of the timeline. The value changes as you zoom in or out and can be set directly from the list.

The timeline uses a visual editing system to aid creation of new motions from assets and transitions. The timeline is centered on one or more motion tracks, which organize motions, poses, trajectories, and transitions in a temporal sequence. Motions for different parts of the body can be organized using different tracks. Each track is usually associated with a different group of body joints. If a DOF is specified in two motion tracks, the higher track takes precedence.

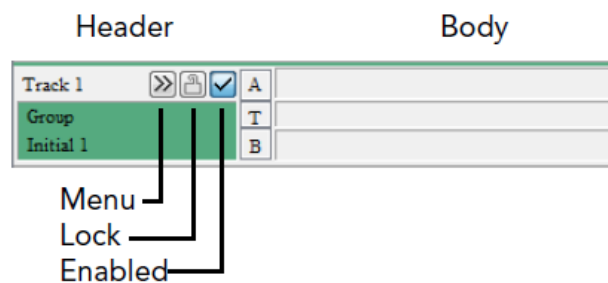
4.2. Opening the Timeline

► To open the Timeline, choose **Window > Timeline**.

4.3. Motion Tracks

A motion track has two sections, the track header and the track body (Figure 39). These areas are described in the rest of this section.

Figure 39. Motion track header and body



4.3.1 The Active Motion Track

Only one motion track is considered the active track and it is important to stay aware of which one it is because it affects many things. The active track's header highlights the track name. You can select a new active track by clicking the header of the desired track.

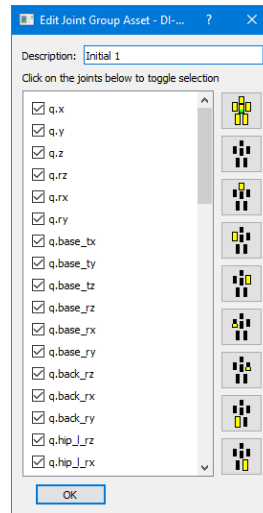
4.3.2 The Motion Track Header

The motion track header has an automatically computed track label (Track 1 for example), a user-editable joint-group label (Group), and control buttons (Figure 39 above). Right-clicking the track's pop-up menu button (or right-clicking on the green Joint Group Asset label) displays a menu from which you can open the Joint Group Asset Editor or scale the track.

Joint Group Asset

If you select Joint Group Asset (JGA) from the popup menu, the Edit Joint Group Asset dialog box opens (Figure 40). You can give the joint group asset a descriptive name. You can select the JGA active degrees of freedom (DOF). You can enable or disable the DOF. The large buttons along the right hand side allow you to quickly select and unselect entire sets of DOFs for most characters.

Figure 40. Edit Joint Group Asset for a motion track



The joint group asset of a track determines which DOF are affected by the data in the track channels. A DOF that is not highlighted is completely unaffected by the motion track.

i DOFs that are not enabled on the active track cause their corresponding textboxes in the Joint Editor and Outliner to be disabled. For more information, see "5.1.1 The Joint Editor" on page 84 and "5.1.2 The Outliner" on page 85.

4.3.3 Creating and Managing Motion Tracks

This section explains how to create and edit motion tracks at the track level. For information about the contents of a track – the track body, see "4.3.4 The Track Body" on the next page

Adding a Motion Track

- To add a new motion track, click the New Motion Track button (📄).

Scaling a Track

You can scale a track such that all the assets in each channel of the track have their start times and their lengths adjusted. The scale can be applied to all the tracks in the Timeline. Locked tracks cannot be modified.

Locking Tracks

The Track Lock button (🔒) indicates whether the data in the track can be modified. You can toggle the lock on to help protect finished work, or off to allow edits.

Enabling Tracks

The Track Enabled button () indicates whether the motion track affects the motion being generated by the Timeline. If the motion track is not enabled then the Timeline motion does not use its data, nor do exported motions use its data. The track itself also can be inspected to see if it is enabled or not. A green line at the top of each track becomes gray when the track is disabled.

Removing a Motion Track

- To remove a new motion track, click the Delete Track button (.

Changing the Order of Motion Tracks

Tracks are listed in the Timeline in numerical order – Track 1, Track 2, and so on. You can move the contents of a track up or down in the order, for example, from Track 2 to Track 3.

- To move the contents of a motion track up or down in the track order, click the Move Track Up or Move Track Down button (.

4.3.4 The Track Body

The track body is made up of three channels named A, T, and B. The A and B channels are motion channels that can hold motions, or poses or trajectories. The T channel only holds transitions.

Motion Channels

You can place motions, poses, runtime poses, and trajectories on the A and B channels. If at any given time there is motion data in the A and B channel (and nothing in the T channel), the A channel always has priority and the motion data in the B channel at that time is ignored. The reason that there are two motion channels instead of just one is so that transition blends can be performed.

Transition Channel - T

You can place any of the transitions on the T channel. If at any given time there is a transition active, its data generation method overrides the data expressed in the A or B channel (although the transition often makes use of this data). There are many different types of transitions. For details, see "4.14. The Transition Toolbar" on page 71.

4.3.5 Managing the Data in a Motion Track

You can manipulate data in the channels in many ways, including:

- Extract character poses and end effector poses with the Grab Pose or Grab Trajectory buttons.
- Use the right-click menus or shortcut keys for cutting, copying, pasting, or deleting.
- Use mouse actions like dragging and dropping.
- Mirroring, cropping, stretching, or launching the context-sensitive editors.

Adding Assets to the Timeline

Motions, poses, and audio assets are usually added to a channel by dragging them from the Project window into the motion channel after they have been imported into the project. Motions, poses, transitions, and trajectories can also be added by pasting assets that were previously cut or copied.

- To add a transition, drag-and-drop it from the Transition toolbar into the transition channel.
- To add a runtime pose, use the Grab Pose button on the Timeline, use the Joint Editor, or drag the 3D View when it is in IK mode.
- To add IK Trajectories, use the Grab Trajectory button (📌).

Cutting, Copying, and Pasting Data

You can cut, copy, and paste motion data. The destination for a paste is highlighted with a marching ants rectangle (Figure 41).

Figure 41. Marching ants rectangle



- To cut, copy, or paste motion data, right-click the data and choose an option from the menu.

Stretching (Time Scaling) and Cropping Motion Data

The operation of time-stretch versus data-crop is based on the cursor mode selected, which is indicated by the cursors, and specified by toggling the suitable Cursor Mode Button. Transition data is easily stretchable in the same manner (but cropping has no meaning for a transition and is not supported).

- **To change the start or end time of a motion or transition:**
 1. Click the first or last frame of the item.
 2. Move the edge frames laterally along the timeline.
- To stretch or crop motion data, click and slide the edges of the box representing the data.
- **To edit data in a dialog box:**
 1. Right-click the data. A menu is displayed.
 2. Choose **Edit**. An Edit dialog box is displayed.
 3. Edit the data.

Deleting Data

- **To delete data:**
 1. Select the data (single-mouse press, or a sweeping mouse-down, mouse-release action).
 2. Press **Delete** or choose **Edit > Delete**.

Previewing Data

► To preview data:

1. Right-click the data. A menu is displayed.
2. Choose **Preview**.

For motion data, unlike the preview described in the Project window, the resultant motion takes into account the modifications you may have done to the motion such as mirroring, stretch, cropping, or extending. You cannot perform such edits directly on an asset that is in the Project window.

4.4. The Time Slider and Time Displays

As you play data using the playback controller of the 3D View, the time slider sweeps across the data in the Timeline, showing the passage of time. To the left of the slider, the frame and time indicators also reflect the current time.

► You can manipulate the current time in any of the following ways:

- Drag the Time Slider.
- Click the time-labels area.
- Edit the current time in the Time Indicator.
- Double-click an asset in the timeline.

When Snap-to functionality () is enabled, it allows you to find the beginning and ends of data.

4.5. Setting a Motion's Range

The range selector (Figure 38 on page 63) controls the start and end time of the motion being created in the Timeline. By default, the range selector is hidden, the start time is 0.0, and the end time is the point in the Timeline after which no data has been inserted.

► To see and edit the range selector, double-click the range selector area.

The active range is shown in green. You can slide the start and end to trim or extend the start and end time.

► To hide the range selector, right-click it and select Default to All, which causes the Timeline to take the defaults.

The range selector affects both playback and motion export.

4.6. Stretching and Cropping a Motion

The stretch and crop controls affect what happens to a motion when you drag its edge with the mouse cursor in a motion track channel. Stretch mode alters the internal DT of the motion, causing time dilation, so that a motion that is stretched longer has an effectively larger internal DT (and seems to run in slow motion). Crop mode preserves the DT of the original motion, but either trims or extends the starting and stopping time of the motion. The information about a slot's stretch and crop edits is displayed in the Info window and in the editors for each slot type.

4.7. Zooming the Timeline In and Out

You can zoom the Timeline in or out. This expands or contracts the amount of time represented in the Timeline. It is purely a GUI feature and does not affect the motion being generated.

- To zoom the Timeline in or out, click the Zoom In () or Zoom Out button (), or select an option in the Time Increment list (Figure 38 on page 63).

4.8. Extracting a Pose

You can capture the state of a character, called its pose, at the current frame. It is placed in a Runtime Pose on the active motion track on the Timeline. If there is no room on the active track, a new motion track is automatically created.

- To extract a pose, click the Grab Pose button ()

4.9. Extracting a Trajectory

You can extract a trajectory from a motion. The motion must have a well-defined single chain for the JGA of the active motion track. The position and orientation of the end effector (that is, of the last joint) of the chain is extracted and placed in a trajectory atom. If an atom already exists, it is re-populated with the current values. If no atom exists, a new one is created. If a trajectory exists to the left or right of the time cursor, it is extended to include the newest atom. For more information, see "3.5. Inverse Kinematics Mode" on page 54.

- To extract a trajectory, click the Grab Trajectory button ()

4.10. Locking the Timeline

Locking the Timeline prevents editing of its contents. It essentially puts the Timeline in read only mode. Motion designers may want to lock a motion track to safeguard its contents.

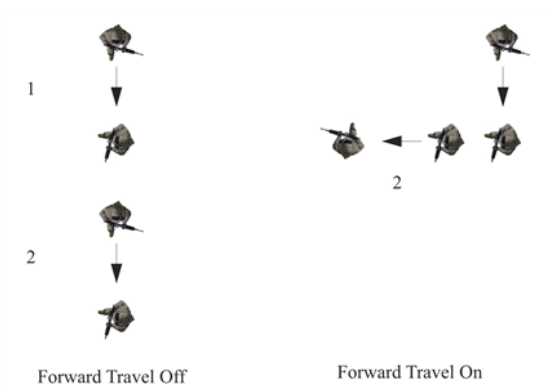
- To lock the Timeline, select the Lock Timeline check box ()

4.11. Enabling Forward Travel Mode

When forward travel mode is enabled, character changes in the X and Y position plus the character's yaw rotation changes for the base joint between motions are preserved. For example, imagine a motion placed on a motion track where the character walked one meter forward and then turned 90 degrees to the right. Now imagine that two such instances of that motion were loaded into the timeline consecutively. If forward travel mode is off, the character walks one meter, then turns 90 degrees to the right. Then it faces the original direction, walks one meter, then turns 90 degrees to the right (Figure 42, forward travel off).

If forward travel mode is turned on, the character faces 0 degrees, walks one meter, then turns to the right. Then it would perform the movement sequence starting from where the first motion terminated, that is, facing 90 degrees. At the end of the entire motion the character would have marched in an L pattern and turned 180 degrees (Figure 42, forward travel on).

Figure 42. Forward travel mode



When combined with blend transitions, this can be a powerful tool for successfully linking together many motions into a larger single motion. Without this feature, you would have to use the offset effect transition and offset poses to produce the same kind of results.

- To enable or disable forward travel mode, select or clear the Forward Travel mode check box ().

4.12. Enabling Snap-to Mode

Snap-to edit mode affects the sliding of data in the motion and audio tracks on the Timeline and the sliding of the time cursor. When it is enabled, the system can help you quickly line up data exactly along various time boundaries. For example, a cubic spline interpolation transition can be stretched to exactly reach the poses that start and end the spline. By default, this feature is enabled. Turning this feature off temporarily may be useful when manipulating data at high zoom levels, or you want to place a resource near something else, but not align it exactly at the same frame.

- To enable or disable Snap-to mode, select or clear the Snap-to check box ().

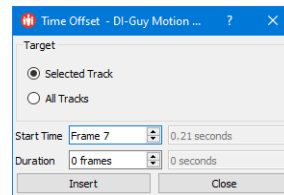
4.13. Offsetting the Time of Assets

You can offset all of the assets in the active track or in all tracks, starting at a specified frame. The offset can be in either the negative or positive direction. There are some restrictions regarding the state of the assets on the tracks that might prevent a successful time offset, such as a starting time that is spanned by a motion, particularly if a negative time offset is requested. Helpful error messages should indicate what violations, if any, the system has detected when testing to see if the time offset can be performed. In addition to repositioning the affected assets, the system attempts to extend and shrink transitions (if needed) so as to maintain continuity.

► **To offset the time of all assets:**

1. Choose **Tools > Time Offset**. The Time Offset dialog box opens (Figure 43).

Figure 43. Time Offset dialog box



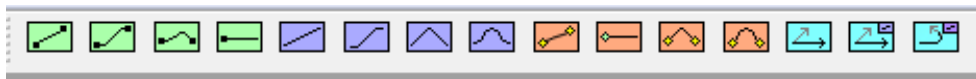
2. Specify a time offset for the selected tracks or all tracks.
3. In the Start Time box, specify the starting frame.
4. In the Duration box, specify the number of frames to offset.

4.14. The Transition Toolbar

Transitions combine motions, poses, and trajectories in ways that result in new motions. The Transition toolbar contains a range of transitions that can be dragged to the transition channel (channel T) of a motion track. The transitions are grouped into four categories, identified by color:

- Interpolation transitions are light green.
- Blend transitions are plum.
- IK interpolation transitions are orange.
- Offset effects are cyan.

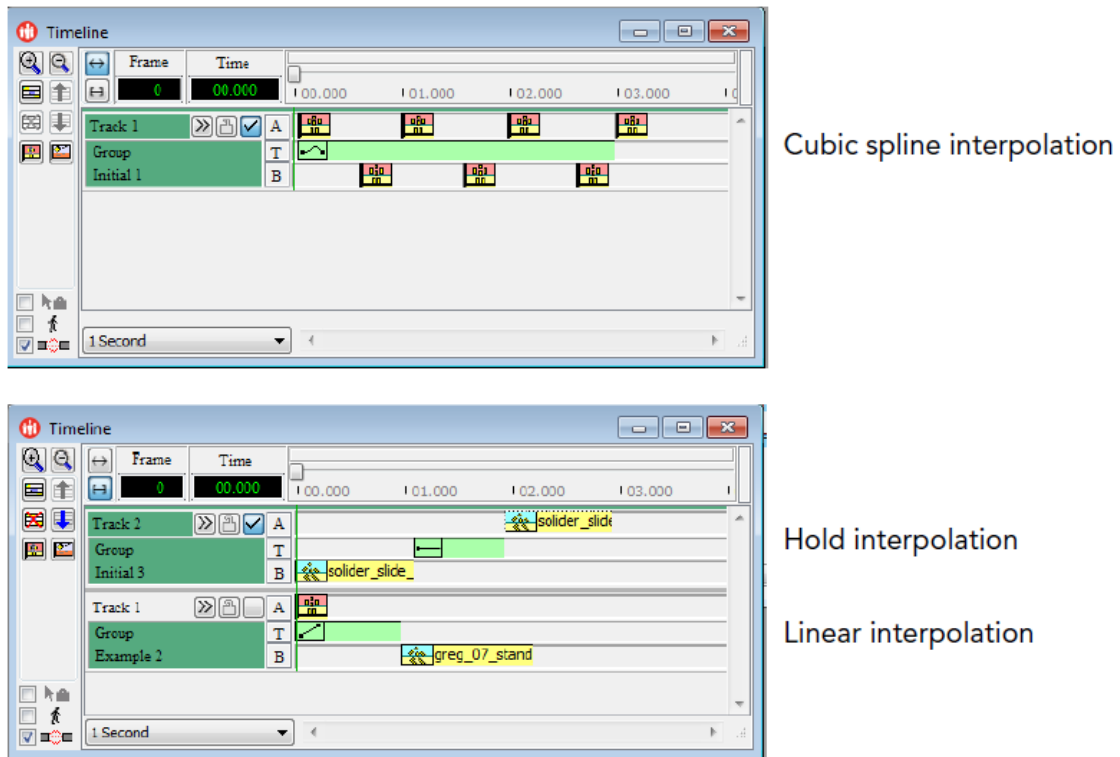
Figure 44. Transition Toolbar



4.14.1 Interpolation Transitions

Interpolation transitions fill in spaces on the timeline (either channel A or B) where motion data has not been defined, typically between two non-consecutive poses. The interpolation transition generates motion for all the frames between the poses that would otherwise be undefined.

Figure 45. Interpolation transitions



In Figure 45, the elements shown in the B channel could be moved up at the same frame to the A channel, or vice versa, without altering the results. Moreover, because interpolations will only consider the first or last frame of a motion, interpolations are basically frame oriented operators. This is unlike blends, which can consider and operate upon an entire motion.

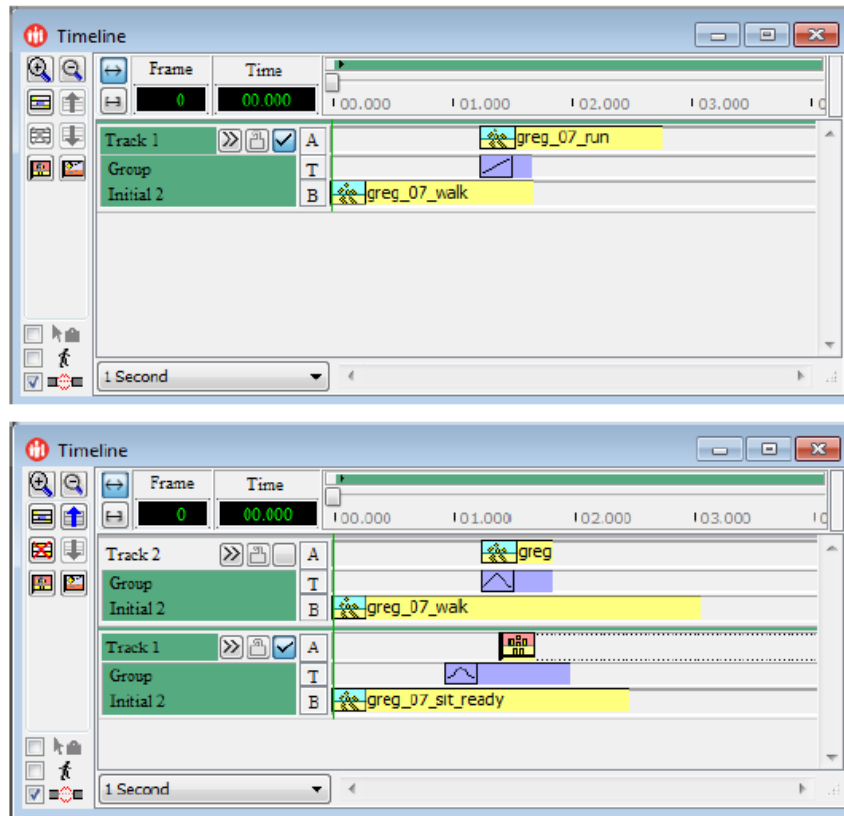
Table 2. Interpolation transition

Interpolation Transition	Function
Linear Interpolation	 Data for each DOF is interpolated linearly between any two positions.
Polynomial Interpolation	 Data for each DOF is interpolated using a polynomial function.
Cubic Spline Interpolation	 Data for each DOF is interpolated using a cubic spline formula that guarantees smooth velocities. Velocity is zero at both endpoints.
Hold Interpolation	 Holds the last pose during a gap. More specifically, it fills in the gaps in the data with the first valid data value found earlier in the transition.

4.14.2 Blend Transitions

Blend transitions can blend two motions together, or a pose and a motion. Blend transitions use different techniques to resolve situations where overlapping motion data exists.

Figure 46. Blend transitions



Linear blend

Teepee blend

Igloo blend

In Figure 46, the elements in channel A and B could be swapped without altering the resulting motion produced by the blend. Unlike interpolations, blends consider all data found within their transition width, so they basically are motion oriented operators.

Table 3. Blend transitions

Blend Transition	Function
Linear	 A linear blend uses a linearly increasing or decreasing ratio to combine the overlap between two motions. In Figure 46, the left edge of the transition takes 100% of its data from channel B and 0% of its data from channel A. Half way into the transition 50% of the blend's data comes from channel A and 50% of the data comes from channel B. At the end of the transition, all of the data is from channel A. It works with two motions (it ignore poses).
Polynomial	 A polynomial blend uses a sinusoidal ratio to combine the overlap between two motions. It is similar to the Linear Blend, except that it more smoothly ramps into and out of the blend. It works with two motions (it ignore poses).

Table 3. Blend transitions (continued)

Blend Transition	Function
Teepee	 A teepee blend blends a motion and a pose or two motions. At the time of the pose, 100% of the data comes from the pose. The ratio of pose to motion data tapers off linearly to zero on each side of the transition. It works with two motions or a motion and a pose.
Igloo	 An igloo blend blends a motion and a pose. At the time of the pose, 100% of the data comes from the pose. The ratio of pose to motion data tapers off in a rounded manner so that there is no velocity discontinuity at the pose or at either end of the transition. It works with two motions or a motion and a pose.

4.14.3 IK Interpolation Transitions

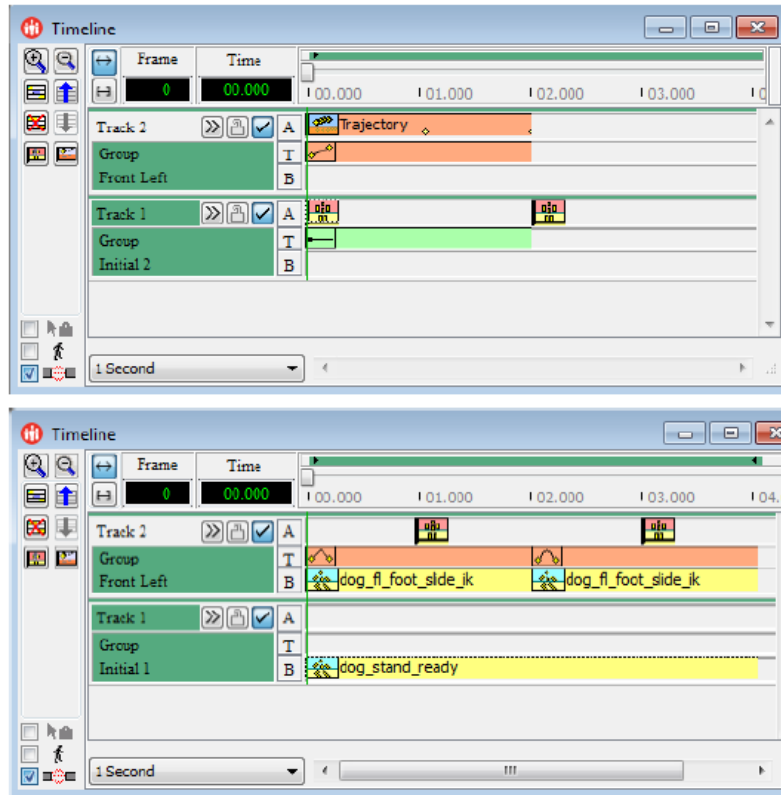
 Use of IK interpolation transitions is recommended for advanced users only.

The igloo and teepee IK transitions work with one motion and one pose. The linear interpolation and hold IK transitions work with one or more trajectory atoms. IK transitions use different techniques to resolve situations where overlapping motion data exists.

IK functions all use inverse kinematics to fill in the empty spaces on the timeline. It is critical to select an appropriate joint group asset for the motion track that is using IK interpolations. The joint group asset should show a single chain of joints with no branching, for example, a single arm or leg.

Because IK almost always deals with a subset of a character's DOF, it is almost always necessary to have more than one enabled motion track in order to get IK to work. Furthermore, because the trajectory information is stored in absolute space coordinates, the lower-level tracks should remain enabled when performing IK edits if the lower tracks control the base position of the character (presuming that the IK motion track does not).

Figure 47. Trajectories



Linear trajectory

Teepee IK blend
Igloo IK blend

In Figure 47, both Track 1 and Track 2 are enabled. Track 1 determines the position of the character's base joint while Track 2 is operating on only a single chain of joints.

The IK is calculated as follows:

- The base position of the IK chain is determined by examining the joint group asset and using the information calculated in the Timeline (including enabled lower-priority tracks) to determine its position and orientation. For example, if the right arm is chosen, the position and orientation of the right shoulder would be the base and its position would be determined by lower priority tracks in the Timeline. Thus, a lower track might define the base and trunk positions that would then be used by this transition.
- The end effector of the chain is determined by examining the joint group asset.
- The goal position and orientation for the inverse kinematics, that is, the position and orientation that the end effector tries to get within a certain tolerance of, is then calculated from the trajectory found in the motion channels of the track.

The various IK interpolation functions vary only in how the goal position and orientation are derived from the trajectory found in the track.

 IK interpolation transitions can be expensive to calculate. Try to minimize the situations where recalculation is required. In particular, we recommend that you place only tracks that modify the base position of the IK chain defined in the JGA below the track containing the IK transition. For example, if you are specifying walking motions for the legs using IK interpolation, place upper body tracks in tracks above the leg tracks. Then, every time the upper body is modified, the leg IK transitions are not recalculated. On the other hand, if you want to modify the Z height of the hips, place that track below the leg IK transitions so that the changes in the hip height force recalculation of the leg IK transitions.

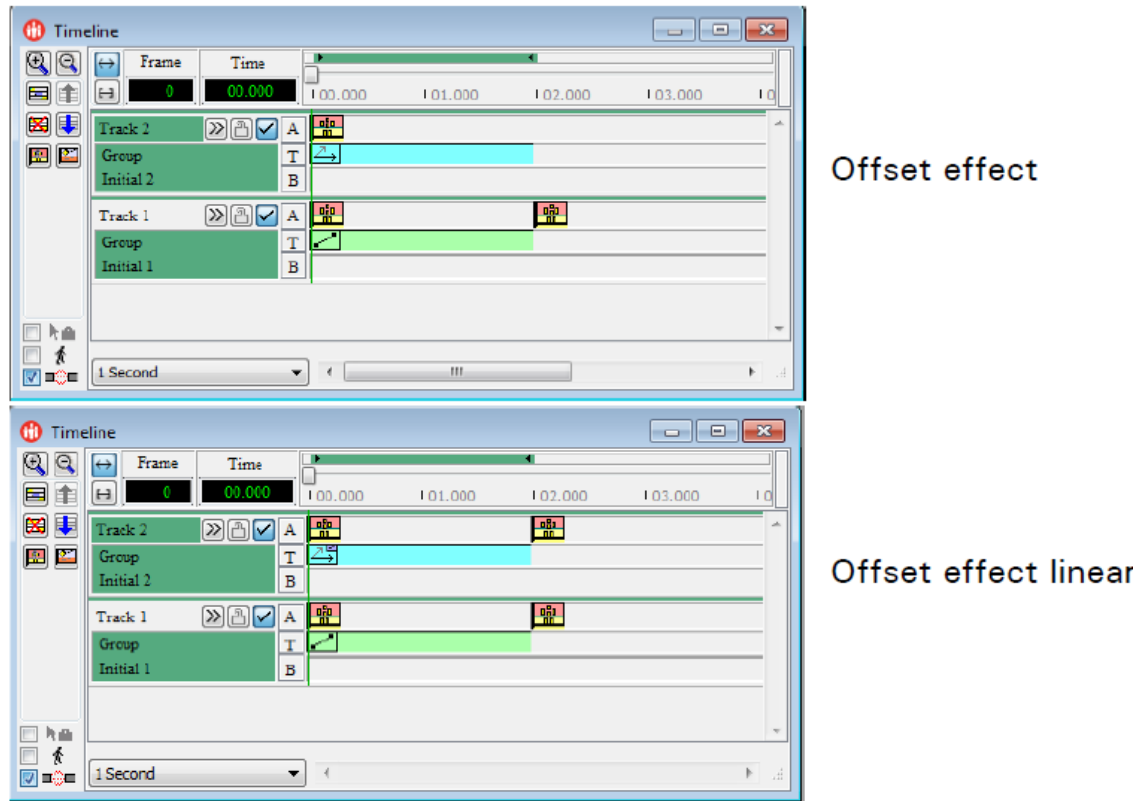
Table 4. Inverse kinematics transitions

Blend Transition	Function
IK Linear Interpolation	 Linear interpolation is used to fill the gaps within the trajectory. It works with trajectories (it ignores motions and poses).
IK Hold	 A simple fill technique is used to fill the gaps within the trajectory. It works with trajectories (it ignores motions and poses).
IK Teepee Blend	 A teepee blend (on the computed end effector) is used to fill the gaps within the trajectory. It works with a pose in the A channel and a motion in the B channel.
IK Igloo Blend	 An igloo blend (on the computed end effector) is used to fill the gaps within the trajectory. It works with a pose in the A channel and a motion in the B channel.

4.14.4 Offset Effect Transitions

Offset effects apply data in their tracks to data already generated by lower motion tracks in the timeline. The Offset Effect () uses a single pose in its track, whereas the Offset Effect Linear () uses two or more poses.

Figure 48. Offset Effect



In Figure 48, both Track 1 and Track 2 are enabled. Typically, the track with an effect on it (in this case, Track 2) has only a few DOF enabled – only the DOF that need to be offset are enabled, while the other track has many DOF enabled (or all of them). Remember that in order to edit an offset pose (those that are in Track 2 in this example), you should first disable all other tracks, and then select the track with the offset pose on it before using the editor.

Offset Effect

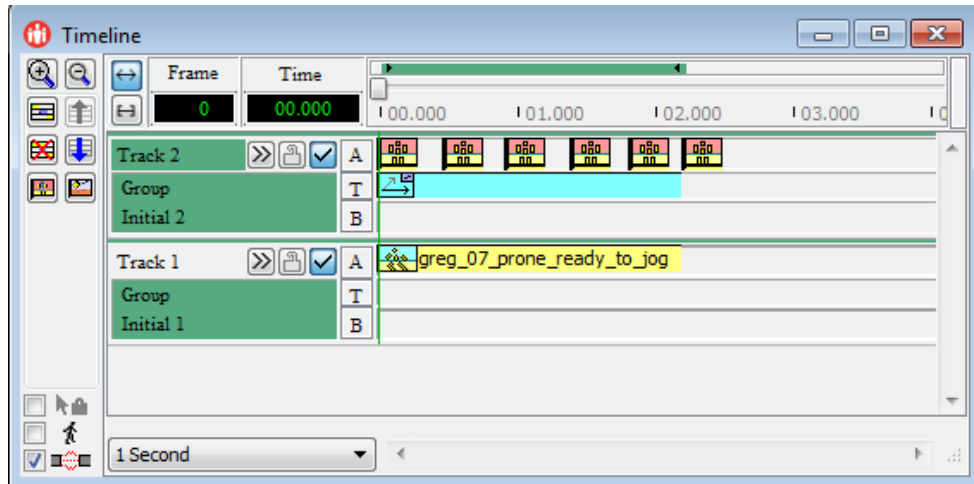
For the offset effect () , the offset values of a pose are applied as an added adjustment to data that is already being generated by the Timeline, coming from lower priority tracks. For example, imagine that you have created a walking motion, but that the motion needs to be offset in the Z direction to get the feet to properly contact the floor. You can create a pose with the desired offset to be applied (so if the feet were 0.17 meters above the floor, you would create a pose with a Z value of -0.17), put that in the A Channel at time 0.0 of a motion track having higher priority than the motion to be modified, and then place an offset effect in the T Channel. For the length of the new transition, the Z value is decremented by -0.17 . It is often advisable to set the JGA to affect only the Z value.

Offset Effect Blend

The offset effect blend () is exactly like the offset effect, except the offset effect blend does not ignore other poses that span its width in the same motion track. It linearly interpolates between each pose to compute the offset values that will be applied as adjustments to the data that is already being generated by the Timeline coming from

lower priority tracks. So, if adding a constant Z value of -0.17 in the previous example is not good enough because the character is not walking at the same height all the time, you can construct an offset effect having many poses, each with a different offset, and the effect will linearly interpolate between those values to compute the offset to apply.

Figure 49. Offset Effect Blend making multiple offset adjustments



4.14.5 Moving a Transition

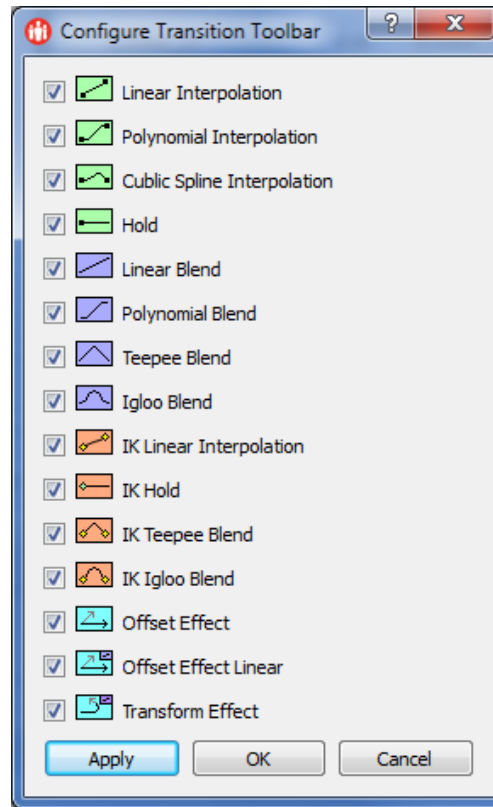
The transform effect button () lets you move a transition to a different point on the timeline.

4.14.6 Customizing the Transition Toolbar

By default, all possible transitions are displayed in the toolbar. You can customize the buttons that are displayed.

► **To customize the Transition toolbar:**

1. Choose **File > Preferences > Configure Transition Toolbar**. The Configure Transition Toolbar dialog box opens (Figure 50).

Figure 50. Configure Transition Toolbar dialog box

2. Select the check boxes for buttons you want to display. Clear check boxes for those you want to hide.
3. Click OK.

4.15. Setting Motion Editor DT

The length of a frame in the timeline is equal to DT (delta time).

► To set motion editor DT:

1. Choose **File > Preferences > Motion Editor DT**. The Motion Editor DT dialog box opens.
2. Specify a value.
3. Click OK.

4.16. Joint Limit Errors Track

Motion designers may want to understand whether the motion currently represented in the timeline is violating joint limits, or if the joints are moving faster than a maximum threshold. The joint error track provides a quick and easy way to determine this information. Two channels are presented: the P channel for position, and the V channel for velocity. The joint limit errors track can be minimized by collapsing its splitter, or it can be hidden entirely using the `-nojointlimit` command-line argument.

i The joint limit errors track is hidden by default. To display it remove `-nojointlimit` from the shortcut for starting the Motion Editor.

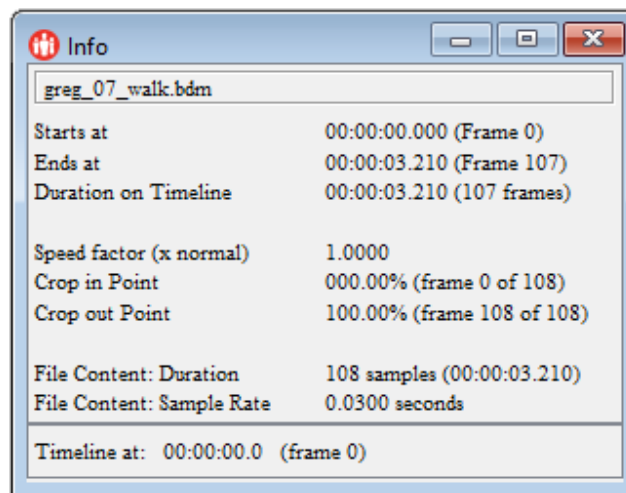
By clicking the Update button, you can immediately request the two channels to be updated. The Auto update forces a joint limit error track recalculation every time the timeline is altered. You may need to alter the track to force an update. When a limit violation is detected, the appropriate channel (P or V) displays a red bar for the frames in which a limit is detected. Additionally, the Joint Editor displays the DOF background in red when the frame is being displayed.

Joint error information is also available from the Joint Editor window. The two can work together to help debug joint limit problems. For example, the joint limit track might show that some position errors occurred on a particular frame, by advancing the time cursor to that frame, you can determine exactly which DOF are causing errors by examining the values represented in the Joint Editor and noticing which values are colored red, indicating a violation. Joint limits (both positional and velocity) are set using the Joint Limits dialog box. (For details, see "Setting Joint Limits".)

4.17. Displaying Information about the Selected Track

You can display detailed information about the selected track. The Info window (Figure 51) shows the position of the selected motion in the timeline, whether it is scaled or cropped, and the original file-content duration and sampling frequency. The last line tells where the Time Cursor is set in the timeline.

Figure 51. Info window



► **To display information about a track:**

1. In the Timeline, select the track.
2. Choose **Window > Info**. The Info window opens.

4.18. Audio Track

The audio track functions similarly to the motion track. Like the motion track, it contains Lock and Enable buttons with identical functions. When the Enable button () for an audio track is on, the top of the track is yellow. When it is disabled, the top of the track is grayed out. Cut, Copy, Paste, Delete, and Preview all behave the same for audio data as they do for motion data, and the audio data can be manipulated by sliding it laterally in the audio track.

► **To import an audio clip:**

1. Choose **File > Import > Audio**. A file selection dialog box opens.
2. Select the file to import.
3. Drag the audio from the Project window to the audio track.

4.18.1 Beat Indicators for Dance Design

The Edit dialog box for an audio clip allows musical beat indicators to be created to allow you to more easily synchronize motions with music. Beat indicators are drawn as tiny red tick-marks below the audio asset. The tick mark is drawn for every beat per minute and the set of ticks can be offset from the beginning of the audio track by a phase angle.



5. Editing Joints

This chapter explains how to edit joints using the Joint Editor and Outliner.

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5.2. Using the Joint Editor	86
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5.1. Introduction

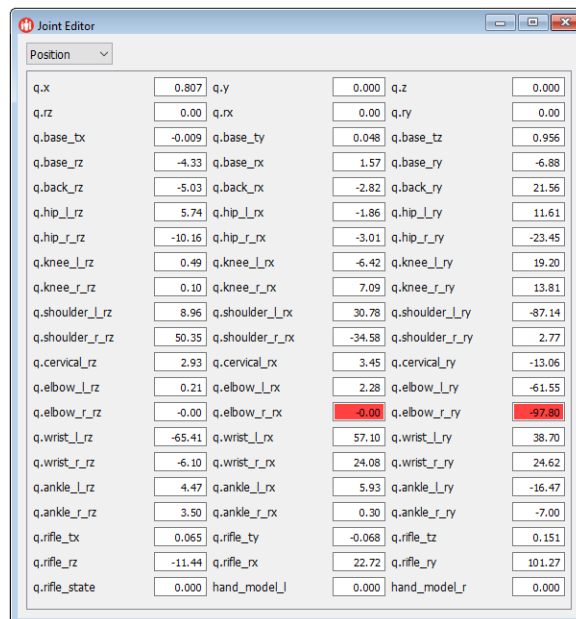
The Motion Editor has two tools for editing joints – the Joint Editor and the Outliner.

5.1.1 The Joint Editor

The Joint Editor (Figure 52) allows you to directly review the values of all the DOF of the character as specified by the timeline at the current time. When position limits are defined, limit violations are shown in red. Editing these values results in the modification (and possible creation) of a runtime pose on the Timeline.

i For offset effects, disable all other tracks to see the values of the track containing the offset runtime pose.

Figure 52. Joint Editor



DOF that are inactive in the current track are shown disabled in the Joint Editor.

i The Joint Editor is updated regularly. On slower systems, updates may affect the performance of the 3D View. Therefore, we recommend that you close the Joint Editor window on slower systems when 3D View performance is important.

Table 5. Joint Editor modes

Mode	Description
Review Mode	In Position mode, see values of each joint (in degrees) for the selected track at the selected time. In Velocity mode, see values for the joint's velocity (in deg./sec.). Items shown in red exceed set joint limits. In this mode, you can also see which joints are enabled or disabled for the currently selected track. Disabled joints are gray.
Pose Edit/Create Mode	To create or edit a pose, make sure the time cursor is at the desired frame and be sure to select the desired timeline Track, then type in a joint's value (you cannot edit Velocity, only Position) or use the Poser. A new pose is created if none exists; otherwise, the existing pose is modified.
Offset Pose Edit Mode	To edit an offset pose, which is a pose used by an offset effect or offset effect linear, first deactivate all of the tracks except for the one containing the offset pose. Make sure it is the selected track before typing in the offset values.

Opening the Joint Editor

- To open the Joint Editor, choose **Window > Joint Editor**.

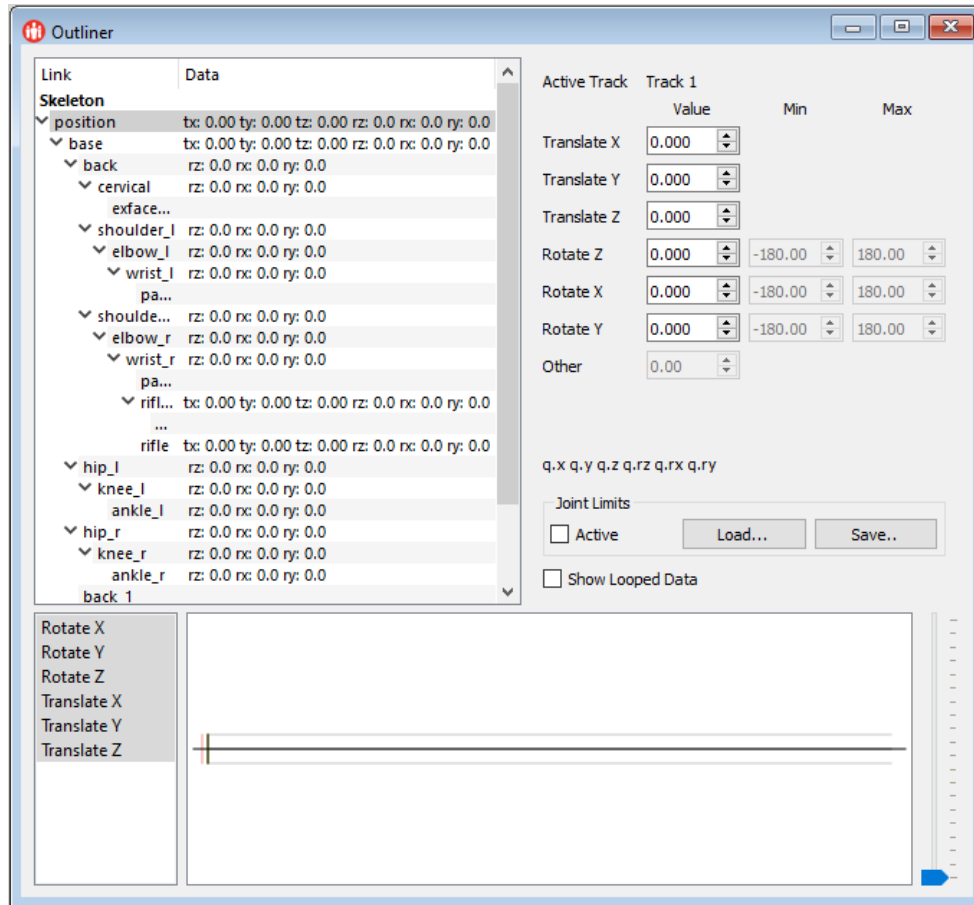
5.1.2 The Outliner

The Outliner (Figure 53) serves the same function as the Joint Editor, but has a friendlier interface. The Joint Editor is more useful if you want to see the values for all of the joints at once. The Outliner has less cryptic labeling, making it easier for you to understand what you are looking at.

At the bottom of the Outliner is a graph of the variables selected from the list on the left, and you can use the slider on the right to adjust the vertical scale of the graph. The graph only generates from playback in the Timeline; previewing an action in the Action Table widget does not update the Outliner.

 In the remainder of this chapter, you can substitute the Outliner for the Joint Editor in most procedures.

Figure 53. The Outliner



Opening the Outliner

- To open the Outliner, choose **Window > Outliner**.

5.2. Using the Joint Editor

To edit DOF data directly, put the Joint Editor in Position mode and type values into the text boxes. If a text box has cursor focus, it does not update normally like the other text boxes, as it might interfere with the attempt to directly enter in a new value.

Any time you change a value in the Joint Editor, the new value is stored in a runtime pose. The Motion Editor tries to locate a runtime pose in the active track at the current time to modify. If it cannot find a runtime pose, it tries to create one at that location. If that location is unavailable, a new track is added to the timeline and the runtime pose is created there.

5.2.1 Velocity Mode

The Joint Editor supports displaying velocity mode, which is read-only. Velocity is defined as 0.0 for Frame 0. For frame n , it is defined as $(P_n - P_{n-1})/(DT)$.

5.3. Joints and Links

A typical DI-Guy character has 15 joints and 48 DOF. It includes an idealized base joint with 6 DOF. Sometimes a character might have a piece of equipment, such as a rifle that also has a base joint with 6 DOF.

Figure 54 shows a schematic representation of the joints and their DOF.

Figure 54. Joints and DOF

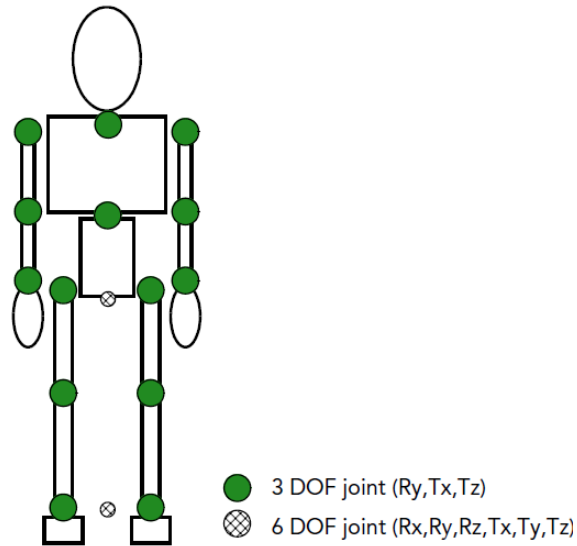


Table 6. Standard DI-Guy link, joints, and DOF names

Joint (DOF) Name	Outbound Body Link
{x,y,z}	idealized joint
r{x,y,z}	idealized joint
offset*	Internal use only
base_t{x,y,z}	pelvis
base_r{x,y,z}	pelvis
back_r{x,y,z}	torso
C7_r(x,y,z)	neck
shoulder_{r,l}_r{x,y,z}	uarm_{r,l} (upper arm)
elbow_{r,l}_r{x,y,z}	larm_{r,l} (lower arm)
wrist_{r,l}_r{x,y,z}	hand_{r,l}
hip_{r,l}_r{x,y,z}	uleg_{r,l} (lower leg)
knee_{r,l}_r{x,y,z}	lleg_{r,l} (lower leg)
ankle_{r,l}_r{x,y,z}	foot_{r,l}

5.4. Generating Joint Limit Reports

You can generate joint limit error reports and stream update reports. You can send them to a file or to the Log. The timeline results are tested for each frame to verify that:

- All DOF velocity values are within velocity limits.
- All DOF positional values are within the joint position limits.
- All DOF values are specified on the timeline for every frame.

► **To generate a joint limit error report and send it to a file:**

1. Choose **Tools > Joint Limit Error and Stream Update Report - File**. A file browser window opens.
2. Specify an output file name.
3. Click Save.

► **To generate a joint limit error report and send it to the Log window, choose **Tools > Joint Limit Error and Stream Update Report - Log Window**.**



6. Configuring the Camera

This chapter explains how to configure and use the camera.

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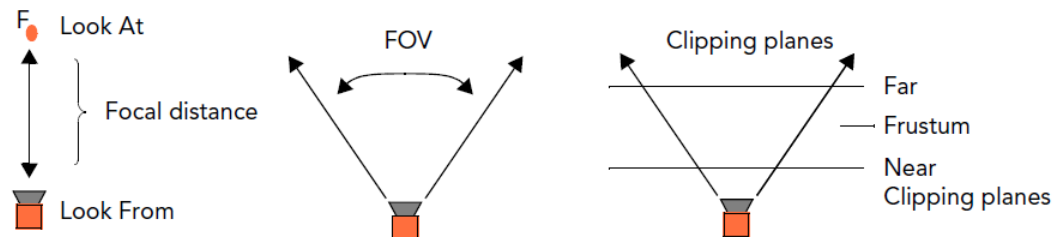
6.1. Camera Terminology

The 3D View renders a character based on a set of camera settings. The seven buttons on the left of the 3D View are default cameras. You can change the settings of the default cameras, rename them, or both.

This section defines the terms used in the camera dialog box to change the camera.

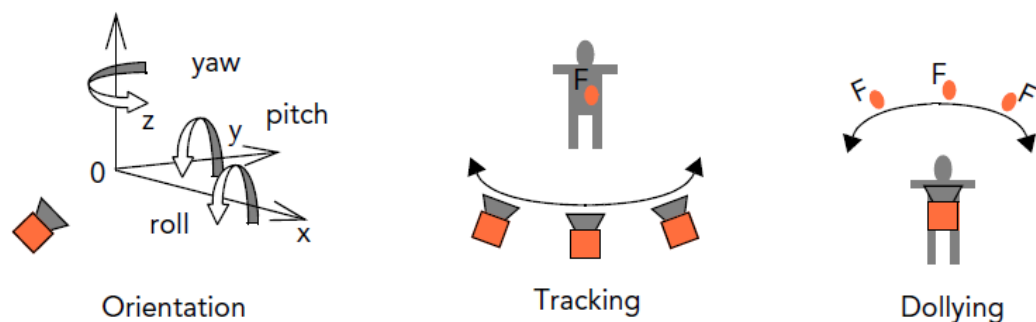
- **Look At (Fixation Point).** A camera looks at a fixation point. Look At can be defined with X,Y,Z coordinates or with objects.
- **Look From (Camera Position).** A camera looks from a camera position. Look From can be defined with X,Y,Z coordinates or with objects.

Figure 55. Look At, focal distance, FOV, clipping planes



- **Focal Dist. (distance).** The distance from the Look At point and the Look From point is the focal distance, in meters.
- **FOV (field of view).** The field of view is the width of the camera view, in degrees.
- **Clipping Planes.** Near and far clipping planes define the near and far limits of the viewing frustum, in meters from the look from point.
- **Orientation.** The camera orientation defines where the camera is pointed. It is set in degrees for yaw, roll, and pitch.

Figure 56. Orientation, tracking, dollying



- **Tracking – Always Look At Character.** The camera is tracking a character if the Look At point follows a character. The Look At character can be further defined to be Look At a specific joint and an optional offset in meters. Use tracking to keep a character centered in the 3D View when either the camera or character is moving.

- Dollying – Always Looks From Character. The camera is dollying with a character if the Look From point follows a character. Use dollying if you want the camera to move with a character.
- Tracking a Character and Dollying to the Same Character with an Offset. This is a particularly useful mode. The camera keeps a character centered in the 3D view as it moves with the character.

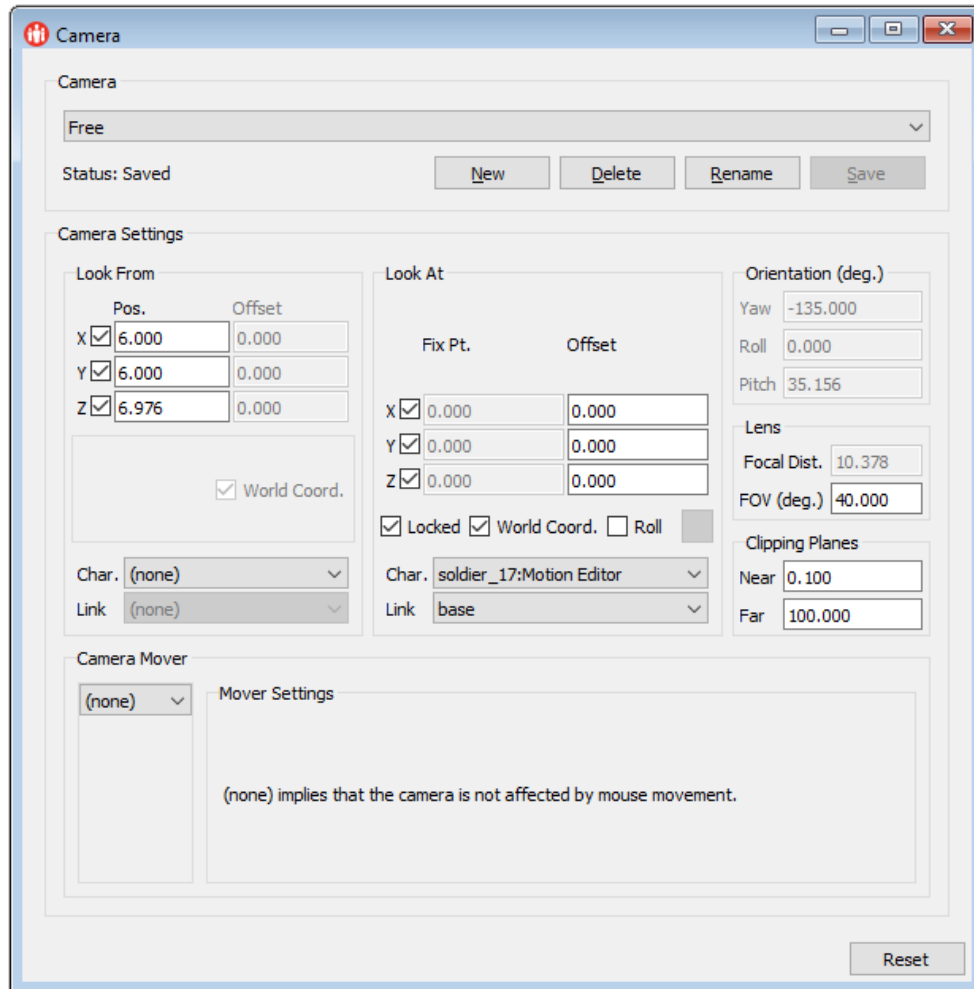


6.2. Cameras and Camera Parameters

The 3D View displays character motions. In any mode, you can:

- Change the camera view, location, motion, and object tracking using mouse clicks and movements.
- Set the camera to follow the action by tracking a character (Looking At) or dollying with a character (Looking From).
- Define and save a camera that includes its view, location, motion, and what objects it tracks.
- Access saved cameras with the default camera menu or hot keys.

You configure the camera in the Camera dialog box (Figure 57).

Figure 57. Camera dialog box

- To open the Camera dialog box, choose **Window > Camera**.

6.2.1 Managing Cameras

The Camera group box (Figure 57 above) has the following controls:

- Camera list. Specifies the name of the current camera.
- New. Click to create a new camera.
- Delete. Click to delete a camera.
- Rename. Click to rename the current camera.
- Save. Click to save the current camera settings with the named camera.
- Status. Saved if the current settings have been saved. Modified if you have made changes, but not yet clicked Save.
- Reset. Click to return to default camera settings.

6.2.2 Camera Parameters

The options in the Camera Settings group box (Figure 57 on the previous page) let you change where the camera is located and what it is viewing.

Table 7. Camera settings

Window Item	Function
Look From group box	Sets where the camera is looking from.
Position X,Y,Z	Location of the camera. If the camera is dollying with a character, then the character determines the camera position.
Offset X,Y,Z	If a dolly character is selected, locate the camera at an offset to the character's selected joint. It is disabled if no character is selected.
World Coord	If selected, the offset uses world coordinates. If cleared, the offset uses local coordinates.
Char	Select a character with which the camera will dolly.
Link	If a dolly character is selected, the link of that character can also be selected. If it is not specified, the base joint is used.
X, Y, Z check boxes	Enables or disables the constraint of where to look from when a look-from character is selected.
Look At group box	Sets what the camera is looking at.
Fix Pt X,Y,Z	A fixation point at which the camera is looking.
Offset X,Y,Z	If a track character is selected, the offset is applied. It is disabled if no character is tracked.
Locked	Sets the camera to track a fixed point in space. (Useful when there is no look-at character selected.)
World Coord	If selected, the offset uses world coordinates. If cleared, the offset uses local coordinates.
Roll	This check box enables the camera to roll away from the Z-up vector. You can then use the vector selection tool (the button to the right) to specify the up vector. This is only available when both look-from and look-at characters are selected.
Char	Select a character for the camera to look at. The camera then tracks this character.
Link	If a track character is selected, the link of the character to track can also be specified. If no link is selected, the base link is assumed.
X, Y, Z check boxes	Enables or disables the constraint of where to look at when a look-at character is selected
Orientation group box	Defines the direction in which the camera is looking. Active only if the camera is not tracking a character.

Table 7. Camera settings (continued)

Window Item	Function
Yaw, Roll, Pitch	Degrees around the Z, X, and Y axes respectively.
Focal Dist	Shows the distance between the camera Look-From point and the camera Look-At point. As the mouse is moved to change the camera, this figure changes. This value rarely needs to be set manually.
FOV (deg.)	Shows the field-of-view of the frustum of the camera. This changes infrequently.
Clipping Planes group box	Determines the amount of culling done.
Near	The camera sees nothing closer than the Near Clip. (Everything closer is clipped.)
Far	The camera sees nothing farther than the Far Clip. (Everything further is clipped.)

6.2.3 Camera Movers

A camera mover specifies how mouse clicks and mouse-drags modify the camera's position and fixation points, and how and when it zooms. There are four different camera mover types: drag, fly, plan view, and none. Movers chiefly affect camera position, camera fixation, camera offsets, and zooming in and out.

Drag Camera Mover

If the camera mover is set to drag, dragging the mouse changes the camera.

- Click either mouse button + drag to rotate the camera position.
- **Shift**+click+drag up or down to change focal distance.
- **Ctrl**+click+drag to pan (camera keeps position, but changes what it is looking at by swinging view left and right, up and down).

Controlling the camera with the mouse provides precise control, but requires repeated mouse actions.

Figure 58 illustrates how the mouse works if the drag camera mover is selected and you have selected an object to track.

- Click+drag. The fixation point is fixed. The camera location changes.
- **Shift**+click+drag. The camera position changes.
- **Ctrl**+click+drag. Camera location is fixed, the camera swivels to change the fixation point.

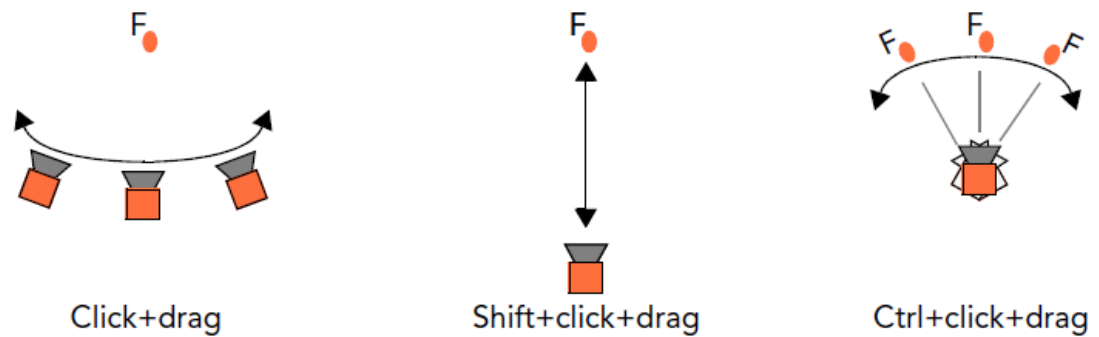
Figure 58. Drag camera mover with tracking

Figure 59 illustrates how the mouse works if the drag camera mover is selected and you have not selected an object to track.

- Click+drag. Camera location is fixed. The camera swivels to change the fixation point.
- **Shift**+click+drag. The camera position changes.
- **Ctrl**+click+drag. The camera and fixation point pan together through space.

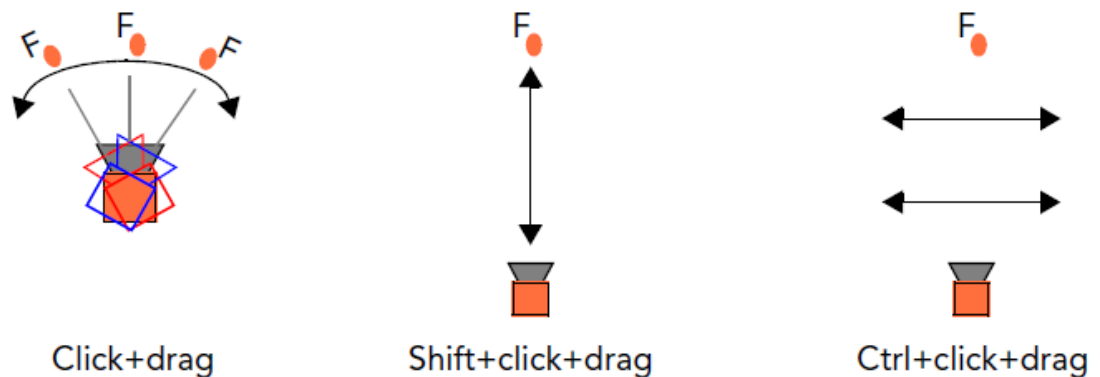
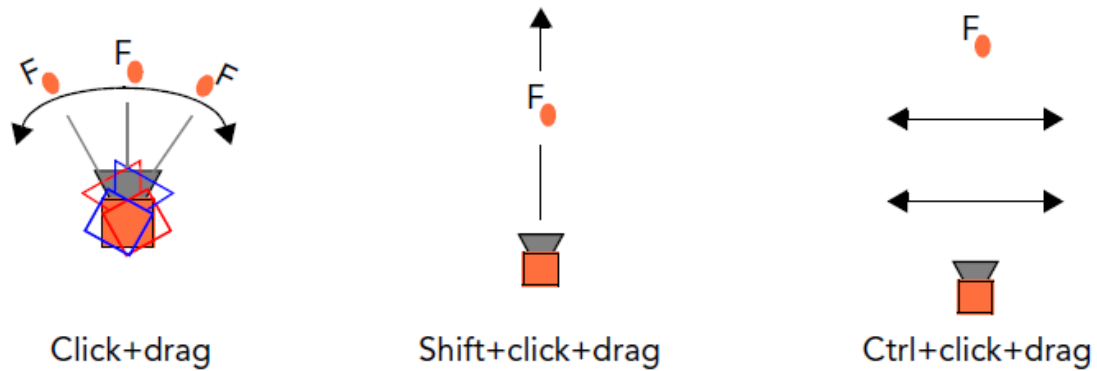
Figure 59. Drag camera mover without tracking

Figure 60 illustrates how the mouse works if the drag camera mover is selected and you have selected a character with which the camera will dolly (in the Look From group box).

- Click+drag. Camera location is fixed; the camera swivels to change the fixation point.
- **Shift**+click+drag. The focal distance is fixed.
- **Ctrl**+click+drag. The camera and fixation point pan together through space.

Figure 60. Drag camera mover with dollying

The drag camera mover has the following speed settings:

- m/pix. Meters per pixel determine how rapidly the camera pans, zooms, or rotates with respect to how far the mouse has been moved.
- deg./pix. Degrees per pixel determine how rapidly the camera pans, zooms, or rotates with respect to pixel movements of the mouse on the screen (that is, how much a mouse drag affects the camera settings).

Fly Camera Mover

The fly camera mover lets the camera fly through 3D space. Little mouse movement is required to covering great distances and the camera flies quickly. However, this movement is not as precise as dragging.

- Press a mouse button to make the camera move quickly (that is, fly) though 3D space.
- Press both buttons + drag to pan or rotate cameras.

Figure 61 illustrates how the mouse works if the fly camera mover is selected and you are not tracking an object. Press and hold either mouse button.

- Left/Right. Focal distance is fixed. The camera and fixation point can change.
- Forward/Back. The camera position changes.
- Up/Down. The focal distance is fixed. The camera looks up and down.

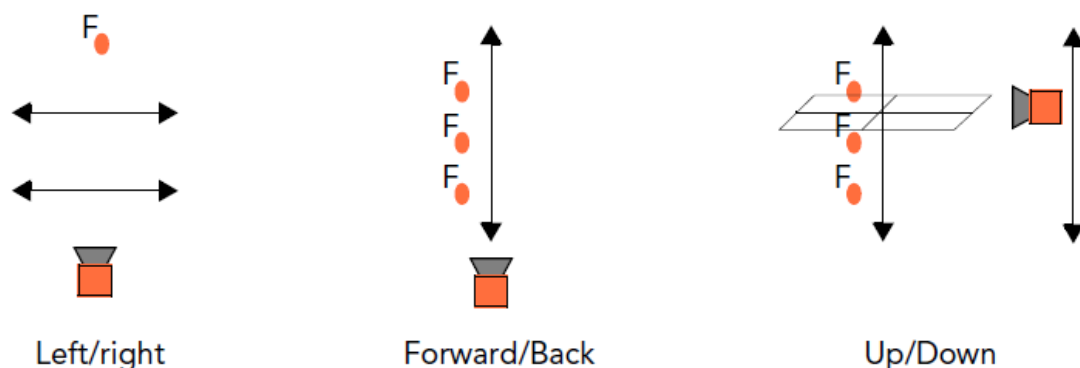
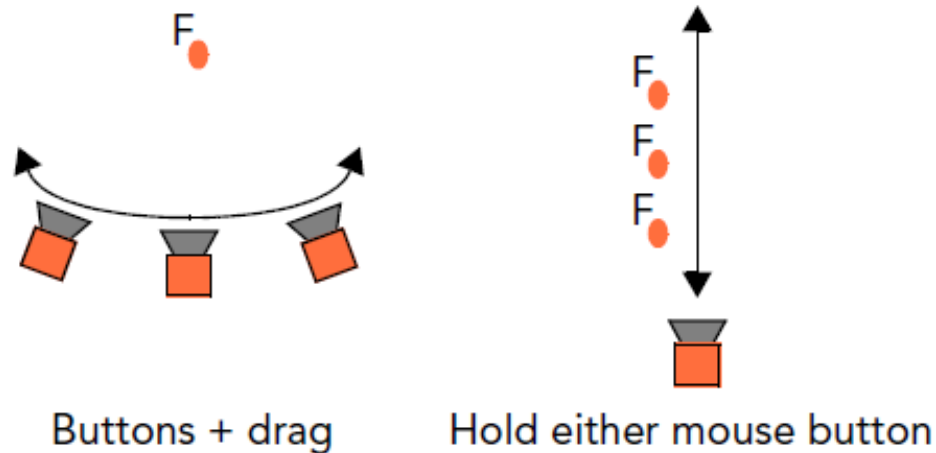
Figure 61. Fly camera mover without tracking

Figure 62 illustrates how the mouse works if the fly camera mover is selected and you are tracking an object.

- Hold both mouse buttons + drag. The fixation point is fixed; the camera location changes.
- Hold either mouse button. The camera position changes.

Figure 62. Fly camera mover with tracking



The fly camera mover has the following speed settings:

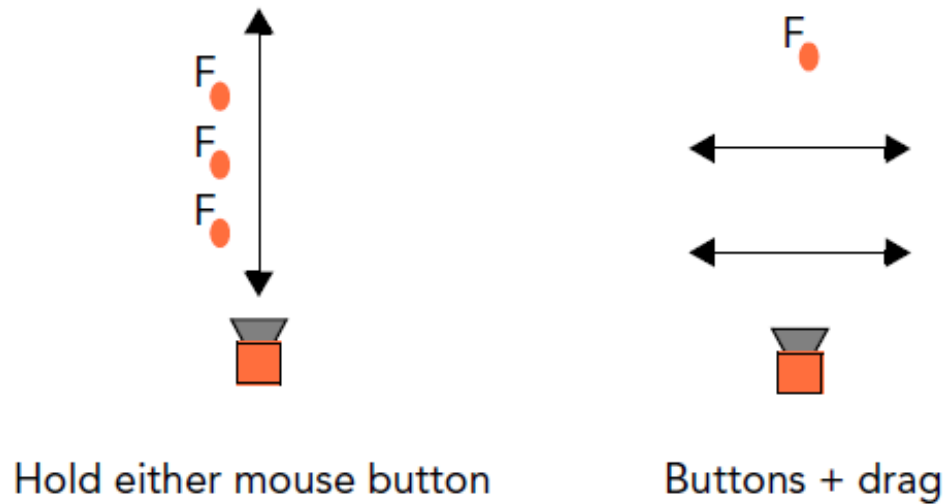
- m/s. Meters-per-second determines how rapidly the camera zooms or pans with respect to how long the mouse has been pressed.
- m/pix. Meters-per-pixel determines how rapidly the camera zooms or pans with respect to pixel movements of the mouse on the screen (that is, how much mouse dragging affects the camera settings).
- deg./pix. Degrees-per-pixel determines how rapidly the camera zooms or pans with respect to pixel movements of the mouse on the screen (that is, how much mouse dragging affects the camera settings).

Plan View Camera Mover

With the plan view camera mover, you cannot reorient the camera. The camera always looks in the direction specified by the Look At setting.

- Press and hold either mouse button. The camera position changes.
- Hold both mouse buttons + drag. The camera and fixation point pan together through space.

Figure 63. Plan View camera mover



The Plan View camera mover has the following settings:

- m/s. Meters per second determine how rapidly the camera zooms or pans with respect to how long the mouse has been pressed.
- m/pix. Meters per pixel determine how rapidly the camera zooms or pans with respect to pixel movements of the mouse on the screen (that is, how much a mouse drag affects the camera settings).
- Look At X,Y, Z grid. Specifies the Look At direction of the camera – specifically, along which axis and in which direction the camera should look at.

None Camera Mover

If None is selected, all camera settings remain fixed and moving the mouse has no effect on the camera.

6.3. Changing the Camera Settings

In every camera mode, clicking mouse buttons and moving the mouse changes the camera. In addition, you can change the camera using one of the following procedures.

6.3.1 Loading Camera Settings

If you save camera settings, you can load them at a later time.

► To load camera settings:

1. Choose **File > Load Camera/IK Settings**. A file browser opens.
2. Select the settings file you want to load.
3. Click Open.

6.3.2 Changing to a Default Camera

The 3D View has seven buttons that activate default cameras (Figure 25 on page 48). A camera consists of the camera location, what it is looking at, how it can move, and other viewing parameters. The default cameras are named according to what the camera is looking at.

- To change to a default camera, click a camera button in the 3D View. The camera changes to the selected camera. The view and the mouse motion change accordingly.

 You can also access the default cameras using keys 1-7 on the keyboard. The first three new cameras that you create can be accessed with 8, 9, and 0 respectively.

6.3.3 Renaming a Default Camera

You can rename the cameras on the camera menu without changing their settings.

 When you rename a camera, its button in the 3D View gets updated to use the new name, so use a name that is short enough to fit.

► **To rename a default camera:**

1. In the Camera dialog box, select the camera you want to rename, or click its button in the 3D View.
2. In the Camera dialog box, click the Rename button. The Rename Camera dialog box opens.
3. Type a new name.
4. Click OK. The camera is renamed and the button in the 3D View updated with the new name

6.3.4 Temporarily Changing a Default Camera's Settings

In addition to being renamed, cameras on the default camera menu can be modified for the current session without changing their permanent settings for other sessions.

► **To temporarily change a default camera's settings:**

1. Select the camera to edit and change any settings in the Camera dialog box.
2. Press **Tab** after each setting to see the change applied immediately. The status label changes from Saved to Modified, which means that changes have not yet been saved.
3. Click Save. The status message changes to Saved. Changes are saved to the current camera.

The current camera retains these settings unless the project is closed or a new project is opened. Importing a project does not change the settings.

6.3.5 Saving a Default Camera's Settings

You can change the settings for a default camera and have the changes persist to future sessions.

► To permanently change a default camera's settings:

1. Change and save settings for each camera in the Camera dialog box, as described in "6.3.4 Temporarily Changing a Default Camera's Settings" on the previous page. You can define more than seven cameras, or less than seven, and they can have any name.
2. Choose **File > Save Camera/IK Settings**. A Save dialog box opens.
3. Give the settings a name.
4. Click OK.

You can load a settings file automatically with the `-i` command-line argument. One potential problem with this is that different characters have different dollying and tracking names, so if the defined cameras track or dolly to a character, only that character-type will work for the settings.

6.4. Enabling Level of Detail

Level of detail changes the resolution of a character based on its distance from the camera. If you enable this preference, more distant objects will be less detailed than close objects.

► To enable level of detail, choose **File > Preferences > View Level of Detail**.



7. Editing Action Tables

This chapter explains how to edit action tables.

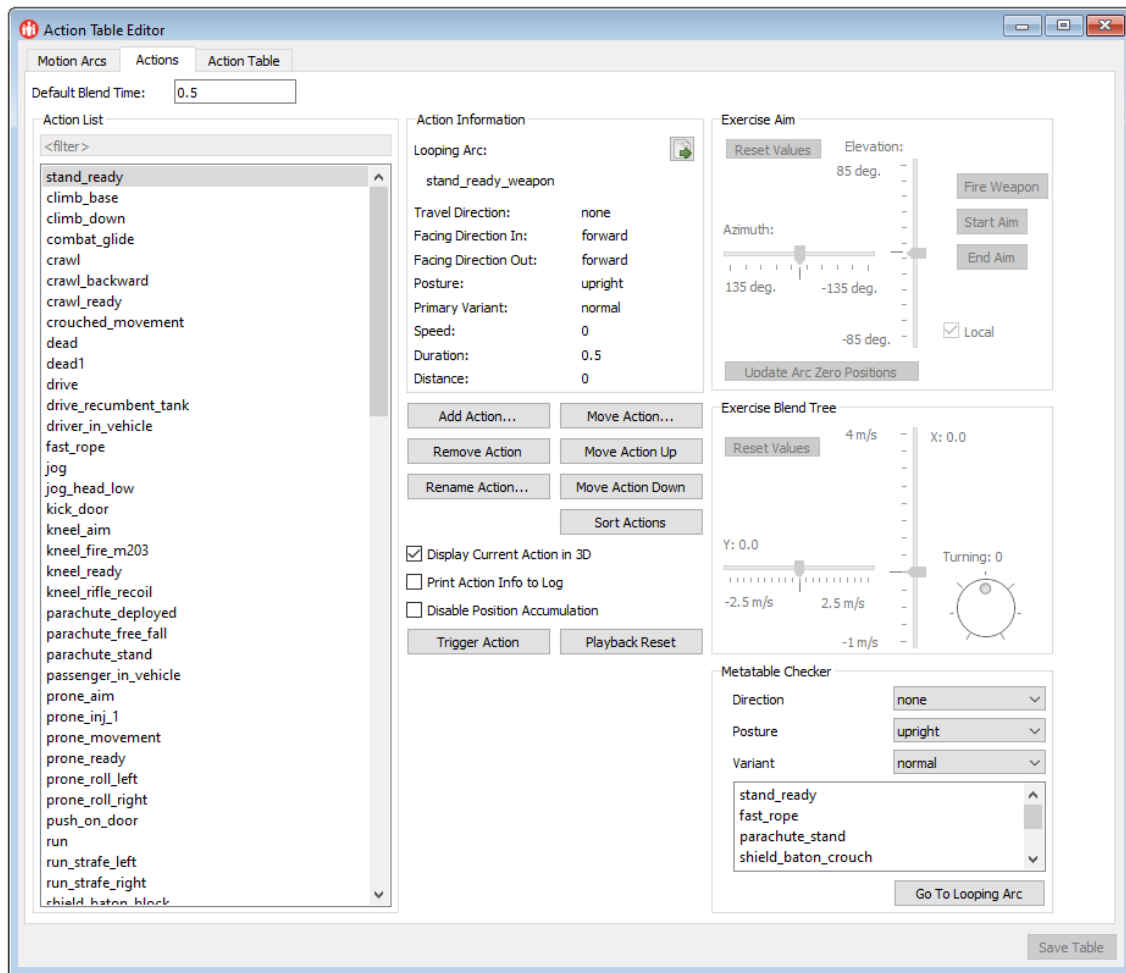
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7.1. Opening the Action Table Editor

The Action Table Editor lets you integrate new motions into a character's motion engine. Every DI-Guy character has an action table of a certain type (square, three-column, or one-column). The action table defines the actions that the DI-Guy character can perform, the underlying motions that are used to perform those actions, and the transitional motions used to transition from one action to another action.

i When the Action Table Editor or the Gesture Table Editor windows are active, they take control of the 3D View. Otherwise, the Timeline window has control.

Figure 64. The Action Table Editor



► To open the Action Table Editor, choose **Window > Action Table**.

7.1.1 Saving an Action Table

After you edit an action table, it is important to save the table.

► **To save an action table:**

1. In the Action Table Editor, click Save Table.
2. Choose **File > Save Action Table**.

7.2. Editing Actions

The Actions tab (Figure 64 on the previous page) defines the actions a DI-Guy character can perform. The actions listed in the Action List are the same actions seen in the DI-Guy Character Viewer and the DI-Guy Data Reference documentation. The details of each action appear in the Action Information group box, including the overall direction, facing direction in and out, the overall DI-Guy posture type (see "7.4. Editing Motion Arcs" on page 111 for details and specifications), the average speed (distance divided by duration), duration, and distance.

When active, the action table controls the character in the 3D View. For example, trigger a new action in the list by double clicking it, or by using the Trigger Action button.

Triggering the action plays the action and performs the transition between the current action and the triggered action. This is an excellent way to test the transition specifications that are configured in the action table.

The Actions tab has buttons that do the following:

- **Add Action.** Adds a new action to the action list. New rows and/or columns are created in the table as needed, and initialized. To see the effect, inspect the Action Table tab too.
- **Move Action.** This button repositions an action relative to any other. It is more convenient than using Move Action Up or Move Action Down when the list is large.
- **Remove Action.** Deletes the selected action from the action table.
- **Move Action Up.** Moves an action up in the list.
- **Rename Action.** Changes the name of an action in the action list.
- **Move Action Down.** Moves an action down in the list.
- **Sort Actions.** Resorts the action list except for the first action, which is the default action for the character (which should be a roughly stationary action). (This is useful after adding or renaming actions.)
- **Trigger Action.** This is the same thing as double-clicking an action in the Action List. It transitions to the selected action, making it the current action.
- **Playback Reset.** Moves the character to (0,0,0) in space, and to time 0 for the default action. This does not undo any edits or changes (the Undo/Redo buttons perform that function). Only the playback is affected.

The order of actions in the action table is, for the most part, irrelevant to DI-Guy.

However, the first action is the default action for a character. Choose an action that is still, such as standing (for human characters). You are encouraged to group actions logically or alphabetically.

The Action Information group box describes the current action. These fields come from the primary motion arc used to define the action, the details of which can be found in the Extended Info section of the Action Table Editor. (For details, see "7.4. Editing Motion Arcs" on page 111.)

- **Travel Direction.** The overall travel direction for the action. For example, forward, backward, right, left.
- **Facing Direction In.** At T-in, the character faces this direction. For example, forward, backward, right, left.
- **Facing Direction Out.** At T-out, the character faces this direction. For example, forward, backward, right, left.
- **Posture.** The Overall Posture as defined by the motion arc. For example, upright, sitting, crouched, prone.
- **Primary Variant.** Which of the variants this action best applies to. For example, normal, socializing, prone, aim, assault, curios, injured, sick, dead.
- **Speed.** The average velocity of the action, in meters per second. (Calculated as distance / duration.)
- **Duration.** The length of time in seconds that the action plays (T-out – T-in) when it transitions to itself.
- **Distance.** The length in meters that the action translates in the X-Y plane when it transitions to itself once.

7.2.1 Aim Primary Variant

When you select an Action from the action list that has its primary variant set to aim, then the Exercise Aim group box is displayed on the Actions tab (Figure 64 on page 102).

The Azimuth and Elevation sliders allow you to test the two degrees of freedom of the aim. The Reset Values button sets both values to zero. The Update Arc Zero Positions button sets the 2-Axis Motion Arc's zero_angle_position (for both axes) to the values of both sliders.

7.3. Editing Action Tables

The Action Table tab displays the contents of the DI-Guyaction table for a character type. Each character type has only one action table.

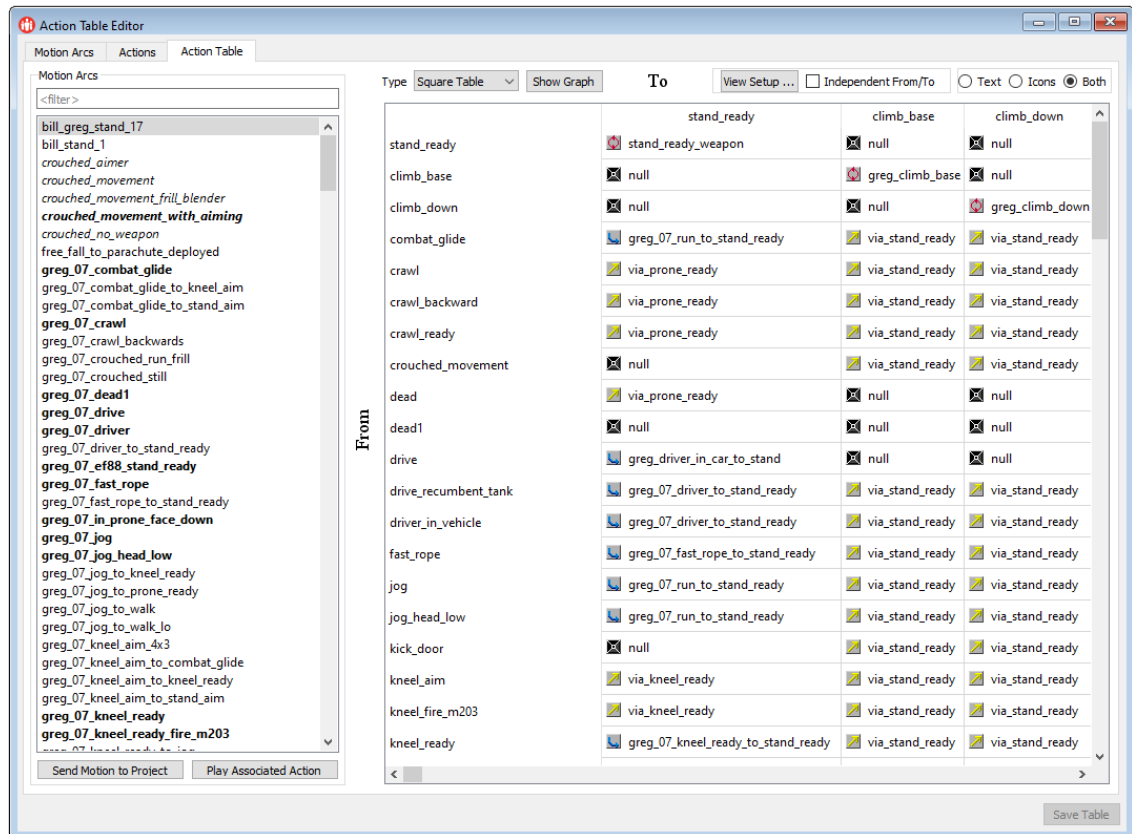
DI-Guy supports the following types of action tables:

- One column
- Three column
- Square table
- Graph.

The one column, three column, and square table types are conceptually the same, a grid of actions and transition. The graph mode is a system for organizing actions into groups that share transitions. It can lower the amount of manual labor in adding new actions.

In Figure 65, the table type is Square Table. Each row and column of an action table is labeled with the name of an action that the character can perform. Each cell in an action table contains either a motion arc, a null motion arc, or a via identifier that specifies the motion arc used to support the transition from the row action (From) to the column action (To). You can drag a motion arc into the action table cell with the mouse while the left mouse button is depressed. If more than one cell in the action table is selected prior to the drop, then all selected cells in the action table are populated with the selected motion arc. Items in the cells can be dragged into neighboring cells, replacing those cells' contents with the dragged item.

Figure 65. Action Table tab



i For a square table, the intersection of a row and a column contains the motion that is used to transition from the row action to the column action (the From and To label to the left and on top of each table).

Square tables have the same number of rows as columns. A single-column table has many rows, but only one column. A three-column table has many rows, but only three columns.

You can specify the kind of action table that a character uses. It is usually OK to increase the complexity of a table (for example from single-column to three-column, or from single-column to square), but it is usually a bad idea to transfer from a more complicated table to a simpler one, because doing so loses information and may result in existing scenarios working differently. Changing the table type is not recommended except for expert users.

i If you change the action table type, the DI-Guy Motion Editor automatically provides a newly populated table of the requested type with initial default values. Use the undo/redo feature to prevent accidentally losing action table settings if you change your mind about the table type.

Double-clicking on a cell always selects that motion arc in the Motion Arcs list.

Clicking on the Send Motion to Project button tries to find the motion data file associated with the currently selected motion arc and automatically imports the data and places it in the DI-Guy Motion Editor's Project window.

The action table has three possible display modes: text view, icon view, and both. The display mode does not affect data.

The View Setup button and Independent From/To check box work together to help you specify which rows and columns of the action table you want to see. Hiding rows or columns does not remove the data.

Table 8 describes the icons used in action table cells when icons are enabled.

Table 8. Action table icons

Icon	Meaning
Looped	 The motion arc in the cell should be able to transition from and to itself. It should be designed to look OK when doing so. This icon automatically appears in certain tables when contextually correct.
Arc	 The motion is usually used as a transition. It should look good when transitioning to and from the other motions it is associated with. This is the generic icon.
Null	 There is no motion arc in the cell. Default motion interpolation may occur.
Via_<x>	 This action should use the same transition as the via-action when transitioning to the destination action.

Dragging a motion arc into an action table cell displays an appropriate icon in the dropped cell. For example, you should be able to find a null or via motion arc in the Motion Arcs list for any character type, and then drag that motion arc into a cell in the table.

7.3.1 Action Table Types

DI-Guy supports four types of tables: square, three-column, one-column, and graph. All types provide information about which motions, if any, should be used to transition from one action to another. For this reason, these tables are sometimes referred to as transition tables.

- One-column. A single-column table has many rows (actions), but only one column. Conceptually it does not support transitions, it just lets you specify the looping motion for an action. Each action transitions to another action directly, instead of through some intermediary motion arc. On-the-fly blending smooths the result.

- Three-column. A three-column table has many rows (actions), and transitions in and out. Each action transitions either to or from another action using the same motion arc. This usually works well when there is a standard neutral action (such as standing) that each action goes to before going to the next action. This is rarely used and is available for legacy reasons.
- Square. Square tables have a transition motion in and out to all other actions. This means that it has Number of actions * Number of actions entries. Each action can transition to and from any other action through an intermediary motion arc.
- Graph. A graphical representation of relationships. Allows grouping of actions into logical groups with transitions between groups.

One-Column Tables

A one-column action table is the simplest table (Figure 66). Each action (that is, row) corresponds to a single motion arc. Each motion arc in this table's cells should be designed to play well in a loop. DI-Guy blends the motions at runtime to transition from one action to another. None of the motion arcs in this table may be of type via or NULL.

Figure 66. One-column table (icon view)

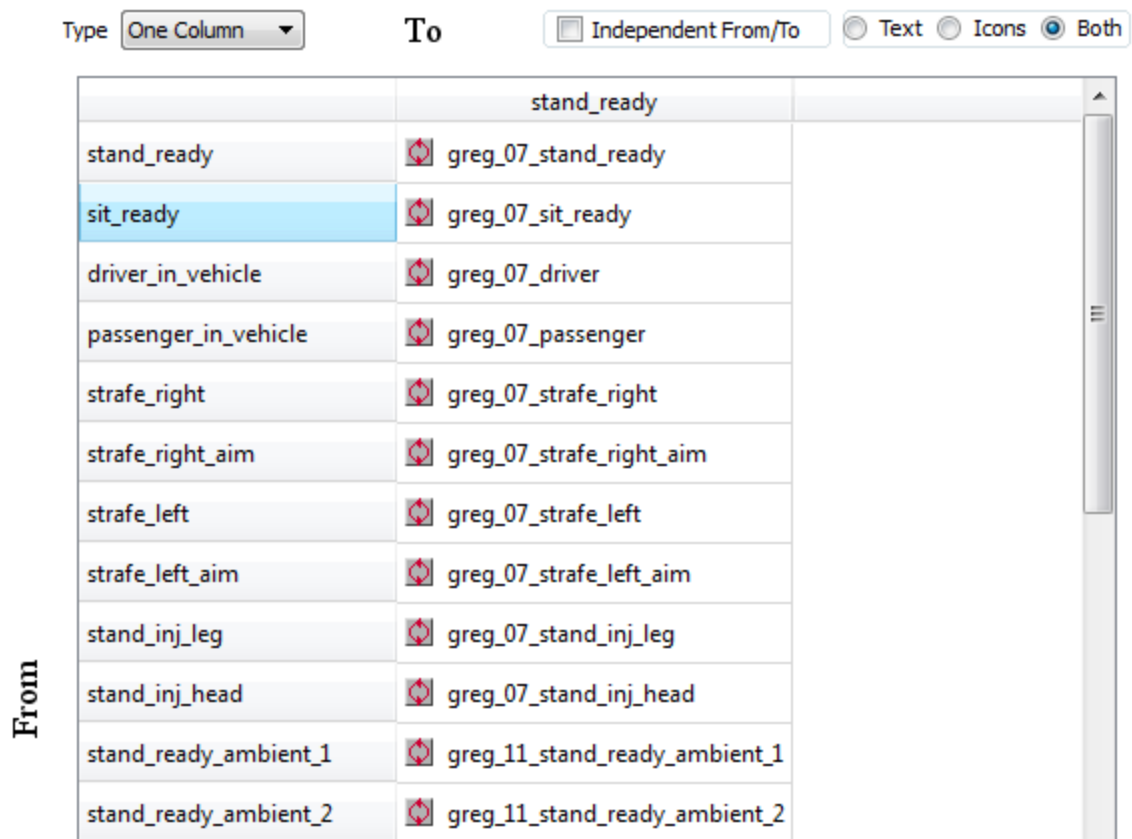
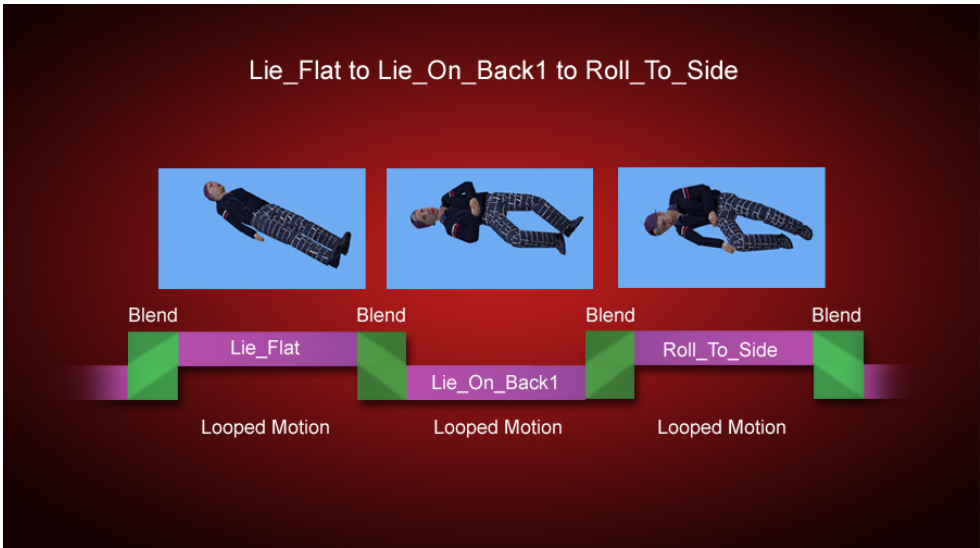


Figure 67 shows how a one-column table would transition from action lie_flat to action lie_on_back1 to action roll_to_side. All three motions in this illustration are looped. DI-Guy does the blending work.

Figure 67. One-column table



Three-Column Tables

A three-column table contains actions with three motion arcs to transition the action in, loop, and out (Figure 68). The looped column (in middle) should always contain a looped motion arc and it is usually the essential motion of the action. The in and out motion arcs may be NULL when there is no need to transition into the looped arc (in which case, that action behaves like a one-column action). None of the motion arcs in this table may be of type via. The center (looped) motion arc cannot be of type NULL. One common technique is to choose a common neutral posture (the same one may be used for all actions) from which the in and out motions blend well.

Figure 68. Three-Column Table (Icon View)

Type: Three Column To: ☐ Independent From/To ☐ Text ☐ Icons ☒ Both

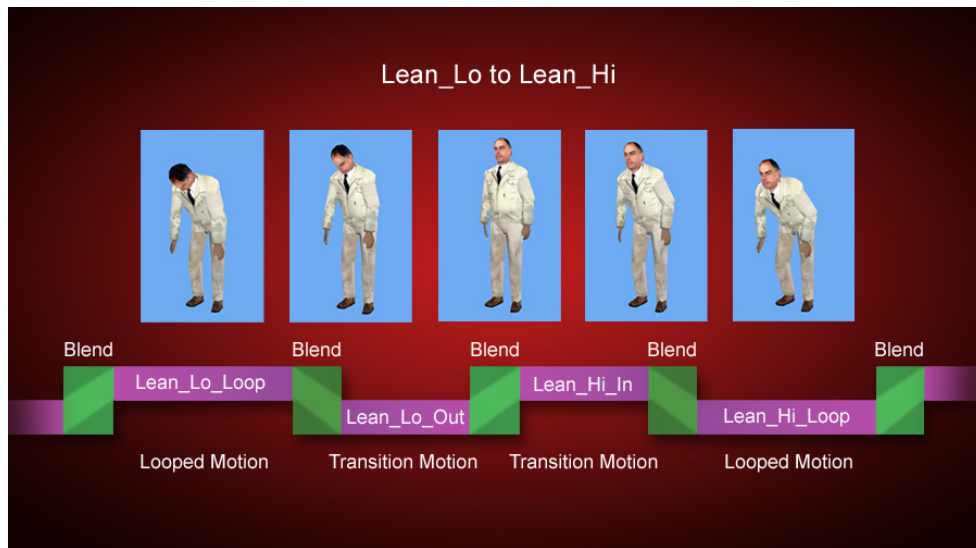
	in	loop	out
stand_ready	null	greg_07_stand_ready	null
sit_ready	null	greg_07_sit_ready	null
driver_in_vehicle	null	greg_07_driver	null
passenger_in_vehicle	null	greg_07_passenger	null
strafe_right	null	greg_07_strafe_right	null
strafe_right_aim	null	greg_07_strafe_right_aim	null
strafe_left	null	greg_07_strafe_left	null
strafe_left_aim	null	greg_07_strafe_left_aim	null
stand_inj_leg	null	greg_07_stand_inj_leg	null
stand_inj_head	null	greg_07_stand_inj_head	null
stand_ready_ambient_1	null	greg_11_stand_ready_ambient_1	null
stand_ready_ambient_2	null	greg_11_stand_ready_ambient_2	null
stand_ready_ambient_3	null	greg_11_stand_ready_ambient_3	null
stand_ready_talk_1	null	greg_07_stand_ready_talk_1	null

Figure 69 illustrates how a three-column table might cause a transition between two (looped) motions to occur by using two intermediate (non-looping) motions. In this example:

1. Motion lean_lo_loop passes through motion lean_lo_out, (the out), into:
2. Motion lean_hi_in (the in), into:
3. Motion lean_hi_loop, (the loop) where it can play repeatedly in a loop if needed.

Switching between the two looping motions (lean_lo_loop and lean_hi_loop) gracefully uses two transition motion arcs. In this case, the neutral posture is standing (middle image).

Figure 69. Lean_lo to lean_hi transition



Square Tables

A square action table (Figure 65) is more flexible than the other table types. However, it takes longer to fill in. Every action can have a specific motion to transition it to every other action. Since every action in a square table can transition to itself, the diagonal of this table should always display looped motion arcs, as shown in Figure 70. Every time a new action is added, transitional motion arcs need to be specified to cover the from and to to every other action, therefore these table types can become large. None of the motions along the diagonal may be of type NULL or via_*.

Figure 70. Simple Square Table

Type Square Table To View Setup ... ☐ Independent From/To ☐ Text ☒ Icons ☐ Both

	stand	stand_long	walk	gallop	dead
stand					
stand_long					
walk					
gallop					
dead					

From

Figure 71 shows how a square table might cause a transition between two (looped) motions to occur by using one intermediate (non-looping) motion. In this example, action stand_ready passes through stand_ready_to_kneel_ready, into kneel_ready, where it can play repeatedly in a loop if needed.

Switching between the two looping motions takes only one transition motion arc.

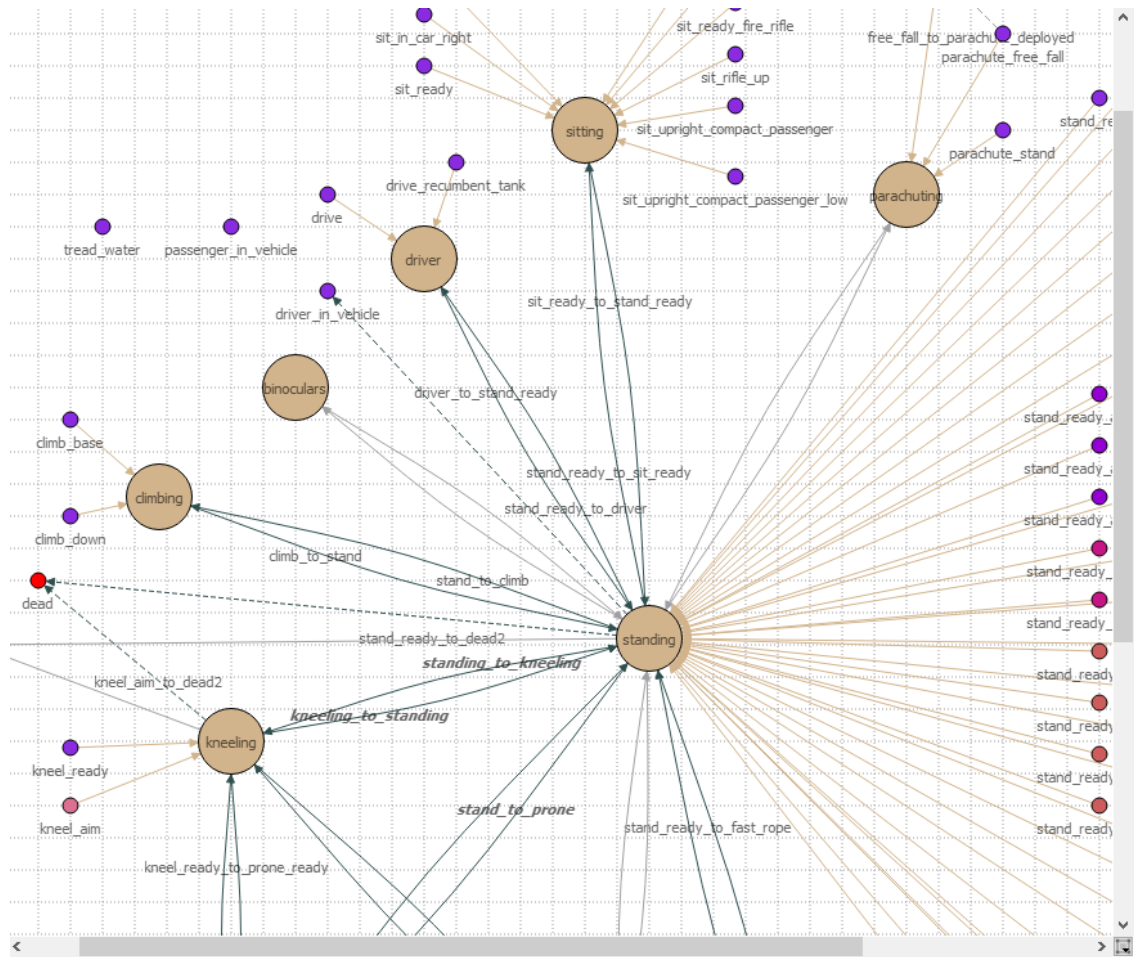
Figure 71. Stand_Ready to Kneel_Ready transition



Graph

The graph (Figure 72) lets you visually see the relationships and transitions and provides a point-and-click interface for changing them. For more information, see "7.5. Editing Graph Action Tables" on page 118.

Figure 72. Graph action table



7.4. Editing Motion Arcs

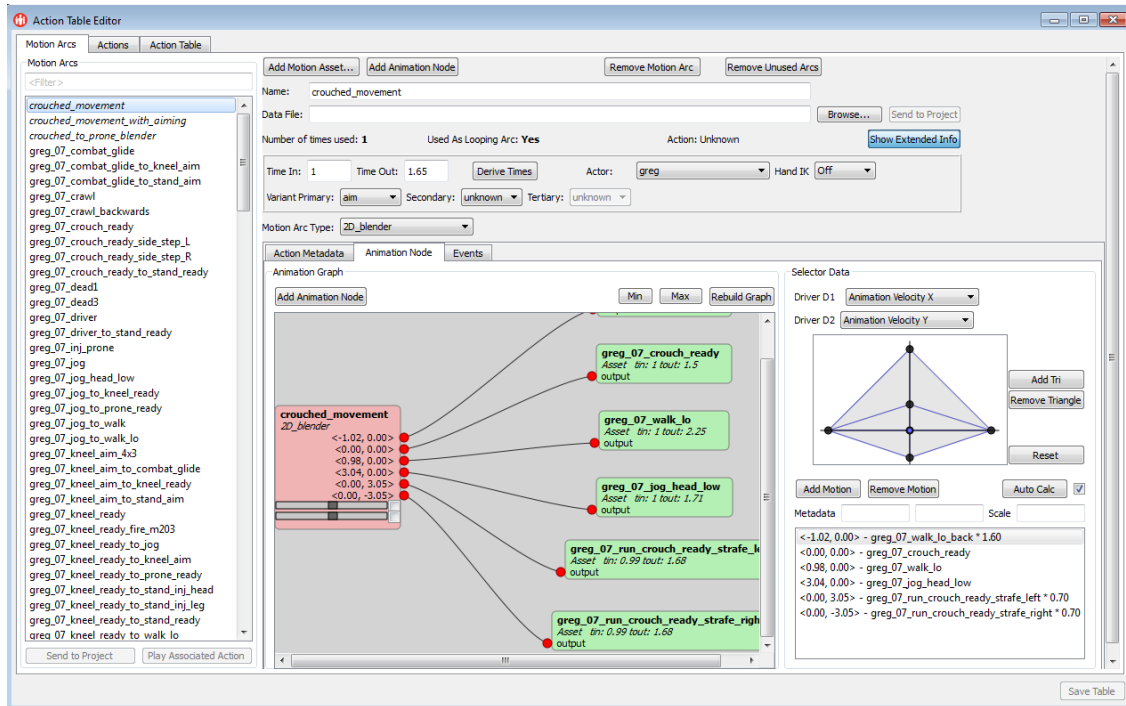
The Motion Arcs tab (Figure 73) lists all available motion arcs that have been created for the current character. It also allows you to edit attributes of the selected motion arc, add new motion arcs, and delete motion arcs.

There are two basic types of motion arcs - ones that point directly to animation assets, and ones that are animation blend trees or motion modules.

 You cannot delete a motion arc if it is used in the action table. You must remove them from the table first.

All motion arcs must have unique names. It is particularly important to set the attributes of a motion arc correctly so that the transition machinery in DI-Guy can automatically preserve character orientation and translation continuity correctly when DI-Guy switches the character from one path to another. You are strongly encouraged to test changes in DI-Guy concurrently.

Figure 73. Motion Arcs tab



By default, when you select a motion arc, the page displays basic information about it. (You can also display extended information.) In particular, the name of the motion arc is shown again, the name of the data file containing the motion, and the number of times that the motion arc is used in the current action table. You can select the Browse button to change the data file associated with the selected motion and click Send to Project button to add the resource to the Project window. It also shows the number of times that the motion arc is in the current character's action table.

7.4.1 Displaying Motion Arc Extended Info

You can display detailed information about motion arcs (Figure 73 above). The information shown depends on the type of the motion arc selected. Null motion arcs and via_* motions have no extended information.

All motion arcs with extended information display the following details:

- **Time In.** The motion arc begin time. Motion data preceding the time in is considered padding data, and is used internally by DI-Guy to perform action transitioning. This is also called T-in.
- **Time Out.** Similar to the Time In, except this is where the motion arc ends. Motion data after this time is considered padding. This is also called T-out.
- **Derive Times.** If this button is pressed, then DI-Guy:
 1. Tries to derive reasonable time in and time out values for the currently selected motion arc.

2. Replaces them.
 3. Marks the motion arc (and therefore the action table) as edited.
 4. Records a history of the event (so that undo/redo can be performed).
- Actor. This refers to a particular person (for human characters) for which the motion was generated for or recorded from. It is important to select the correct actor so that different actors can play the motion data without it looking inappropriate on them. In particular, since the heights of different DI-Guy characters differ, DI-Guy must scale the motion arc data designed for other actors when playing motions on a different actor in such a way that the feet of any character will reach the floor. For example, DI-Guy minimizes slippage of the feet that might occur during walking or running.
 - Motion Arc Type. The type of a motion arc determines how DI-Guy plays the motion back, and also determines what kind of role the motion can serve for the character. The values can be one of the following:
 - unknown. Deprecated.
 - null. The selected motion arc is NULL, meaning there is no motion arc in the selected table cell. This is not typically selected.
 - motion. More than four frames of data are required of this motion type. The motion should have padding, and time-in and time-out set appropriately. DI-Guy plays each frame of data except the padding, which is used to compute transitions between actions.
 - pose. One frame of motion data is required of the motion. Time is ignored and so is the frame rate, time in, and time out, because they are not applicable.
 - 2-channel pose. Deprecated.
 - 1-axis pose. Two frames of motion data are required of the motion. (Time is ignored, so the frame rate, time in, and time out are considered not applicable.) The motion describes the two postures that are to be transitioned between as a single axis value changes between two extremes. This is useful with joystick-control.
 - 2-axis pose. Four frames of data are required of the motion. (Time is ignored, so the frame rate, time in, and time out are considered not applicable.) If the four 2-axis frames of data are thought of as corners of a rectangle, then the frames [0, 1, 2, 3] of the motion correspond to these corners of the rectangle: {lower left, upper left, lower right, upper right}. The motion describes the four postures that are to be transitioned between as the values of a two axes vary in a finite, rectangular region. This is useful with joystick-control.
 - 2-channel motion. 2 channel motions are used by gestures.
 - vehicle. Designates a vehicle_09 motion.
 - via_action. This type is actually a convenient shorthand way of indicating to the action table that a transition (say from action A to action B) should first transition to the via action, and then the via_* action transitions to the destination action. For example, suppose a character who can do pushups and

for whom you have built a new jumping jack motion. Instead of creating a jumping jack to pushup motion, you could instead use `via_action stand`, which would have the character transition from jumping jack to stand, and then from stand to push ups.

The Motion Motion Arc Type

Motion is the most commonly used motion arc type found in the Motion Arc list. The Motion motion arc type has the following parameters:

- Travel Direction:
 - Overall. The conceptual direction of the motion arc.
 - At T In. The direction that the motion starts at during T-in.
 - At T Out. The direction that the motion ends at during T-out.
- Posture:
 - Overall. The conceptual direction of the motion arc.
 - At T In. The posture that the motion starts at during T-in.
 - At T Out. The posture that the motion ends at during T-out.
- Variant. Normal, aim, dead, angry, assault, curious, exercise, unknown, any, and so on. By classifying a motion with a variant, DI-Guy can be queried for an action and return the best fit. For example, you may ask for a stationary action with variant angry, and the character will play a protest action. You can set primary, secondary, and tertiary variants.
- Blend Type. Exponential-5, Exponential-10, Half-Sine, Linear, Quarter-Sine, Step-Halfway, Waver.

The possible values for direction and posture are described in the following sections.

Direction Types

The direction of a character is also referred to as its facing. Knowing the direction of a motion at the beginning, looping-part, and ending of a motion can be important to DI-Guy since it must automatically manage the transitions between various actions, and this usually means keeping some amount of continuity in the facing of the various motion arcs that underlie each action. Table 9 lists the direction types. These terms are used for the Travel Direction Overall, Facing Direction T-In, and Facing Direction T-Out parameters.

Table 9. Direction types

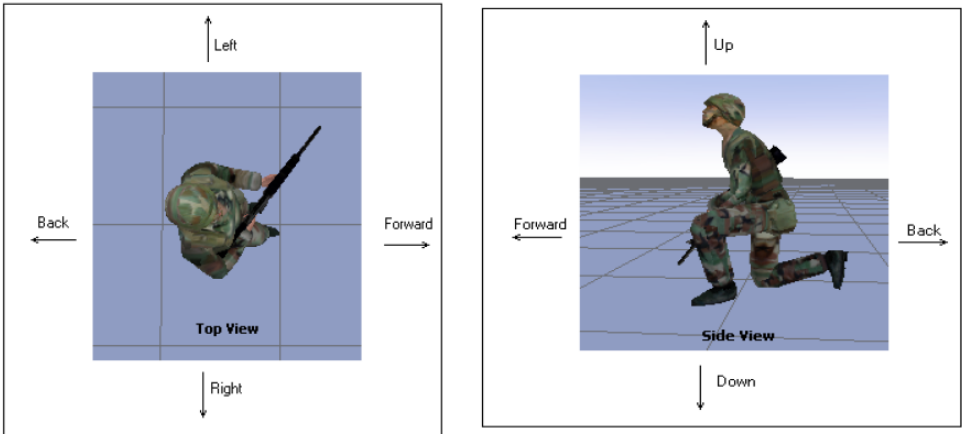
Direction Type	Description
none	A stationary motion, such as stand. Most motions are either none or forward. None motions mean that the loop has no change in translation and rotation.
forward	The character moves forward down the X-axis. Along with none, the most common motion type.

Table 9. Direction types (continued)

Direction Type	Description
backward	Backward movement. (Advanced users only.)
left	Leftward movement (usually a side-step). (Advanced users only.)
right	Rightward movement (usually a side-step). (Advanced users only.)
up	Rising movement (for example, rise from sitting). (Advanced users only.)
down	Downward movement (for example, sitting down). (Advanced users only.)
turn left	If the character starts facing forward, but during the motion rotates to the left 90 degrees, then the overall travel direction is turn left, the T-in direction is forward, and the T-out direction would be left. (Advanced users only.)
turn right	If the character starts facing forward but during the motion rotates to the right 90 degrees, then the overall travel direction is turn right, the T-in direction is forward, and the T-out direction would be right. (Advanced users only.)
nonlinear	The motion does not move along any particular axis in a regular manner. (Advanced users only.)
linear off-axis	The motion moves along an axis, but not the X, Y, or Z axis. For example, if the character starts facing forward, but during the motion rotates to the left only 30 degrees, then the overall travel direction is turn left, the T-in direction is forward, and the T-out direction is linear off-axis. Use of this setting is strongly discouraged. (Advanced users only.)
inherit	The motion direction takes on the corresponding direction of the previous motion arc (that was used to transition into this motion arc). (Advanced users only.)
unknown	This means that the direction type has not been specified. Use of this setting is strongly discouraged. (Advanced users only.)

Figure 74 shows examples of the direction types. The images assume that a motion arc moves the character's base joint in the direction of the arrows.

Figure 74. Direction types



Posture Types

A character's posture type (or motion arc) is important to DI-Guy for many of the same reasons that the direction is, but it is particularly important for querying uses such as joystick manipulation, where buttons are assigned to control the posture of a character in a consistent and intuitive way. Table 10 lists posture types. These terms are used with Posture Overall, Posture T-In, and Posture T-Out parameters.

Table 10. Posture types

Posture Type	Description
upright	The character is standing vertically, or nearly vertically.
crouched	The character is standing, but bent forward significantly, or kneeling.
prone	The character is lying horizontally, or is very low.
sitting	The character is sitting.
any	The (looped) motion arc spans across multiple posture types.
unknown	The posture type has not been specified.

The Pose Motion Arc Type

The Pose motion arc is a relatively rare, simple motion arc type. It involves only one frame of data, only one facing, and only one posture description. Since it ignores time, there are no T-in or T-out qualifiers to populate. The fields have roughly the same meaning as in the Motion motion arc type.

The NULL Motion Arc Type

When the Motion Arc Type is set to Null there is little additional information to display. The Blend fields have roughly the same meaning as in the Motion motion arc type.

The Unknown Motion Arc Type

You cannot set the Motion Arc Type to Unknown. However, if an unknown motion arc is selected from the Motion Arcs list, the blend duration and blend function is displayed. This information is read only.

The Via_action Motion Arc Type

You cannot set the Motion Arc Type to `via_action`. However, if you select one of the `via_*` motion arcs listed in the Motions Arcs list, the name of the action that supplies the transition details of the `via_action` is displayed.

The 1-Axis Pose Motion Arc Type

1-axis poses are used for tasks like aiming, where a parameter is used to index into a pose space defined by the motion arc. Two poses are then included at two different points along the axis, for example, a left-aiming pose and a right-aiming pose. The parameter is used to index into a pose derived using interpolation from the two definition poses.

The information for Motion Arc type 1-Axis Pose involves only two frames of data. Since it ignores time, only one facing and one posture description is necessary, and there are no T-in or T-out qualifiers. The Min Axis and Max Axis settings define the range of the parameterization (as if positioning along the axis) usually associated with a DI-Guy bead (such as an aim bead). The Divisions allow you to edit the motion division frames. The other fields have roughly the same meaning as those for the Motion motion arc type.

The 2-Axis Pose Motion Arc Type

2-axis poses are identical to 1-axis poses except they use four poses that define the 2D pose space (along two independent axes) that retrieve poses based on two parameters. The other fields have roughly the same meaning as those for the Motion motion arc type.

The 2-channel Pose Motion Arc Type

2-channel poses are not recommended.

The 2-channel Motion Motion Arc Type

Gestures can use two channel motions, often with different intensities of gestures. You can then parameterize how much of each channel they want for the final gesture.

The Vehicle Motion Arc Type

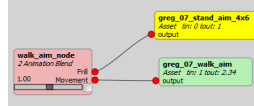
Vehicle_09 motions only.

7.4.2 The Animation Node Editor

The Animation Node Editor allows you to build an animation blend tree, a standard part of most animation engines. This allows blending between similarly timed motions. We can interpolate between run and walk to create a new animation that is somewhere between the two. A module that supports fading in part of the body can allow the character to run on the lower body while aiming with the upper body. There are many modules and variables that can drive those modules.

Motion arcs whose names are displayed in italics can be edited in the Animation Node Editor. Figure 75 illustrates the animation node for the `walk_aim_node`. This animation blend allows a character to transition from walking and aiming to standing and aiming without needing to go through an intermediate default `stand_aim` action.

Figure 75. Animation node



For detailed information about the animation node editor, contact support at <https://www.mak.com/mak-one/support/portal>.

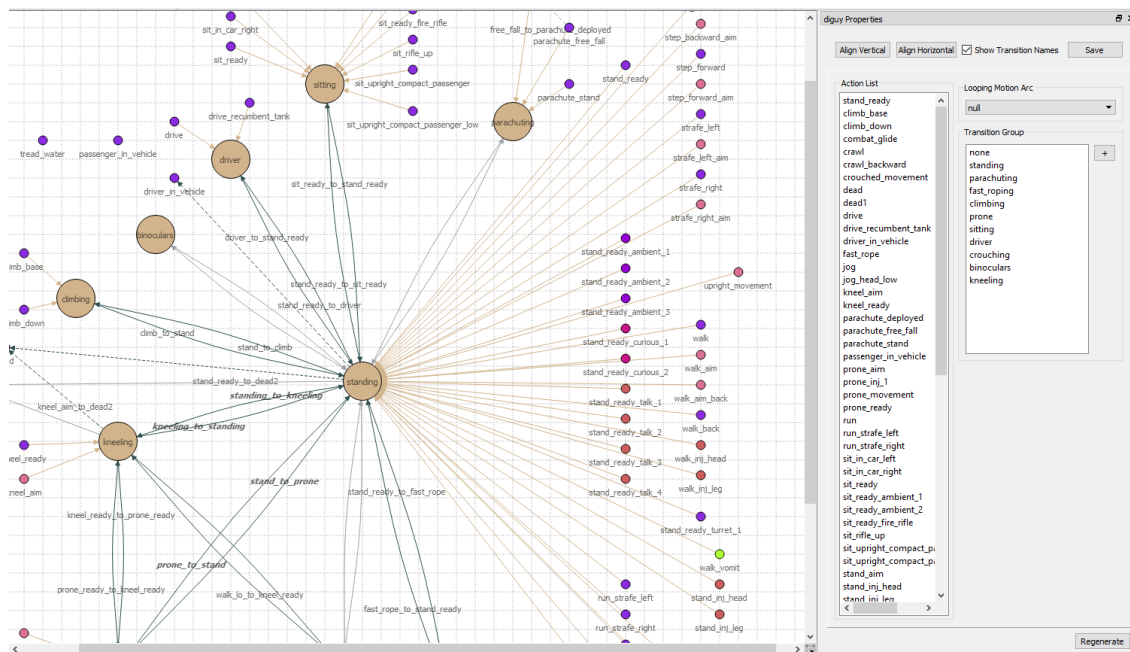
7.5. Editing Graph Action Tables

Graph action tables were introduced in DI-Guy 13.5. (Most characters continue to use square tables. However in coming releases characters will be converted to the graph mode.) For developers creating new characters or making significant edits to existing characters the graph format may be significantly easier to use than square tables, particularly for characters that have many actions. Additionally, the configuration files created by graphs are significantly smaller than those of equivalent square tables. For an example of a graph action table, load the `soldier_action_graph` character. It is roughly equivalent to the `soldier_17` character.

You can convert a character from a square table to a graph, but as with conversions between the columnar table types, all configuration information is lost and you must rebuild all the transitions.

Figure 76 shows the graph for the `soldier_action_graph` character. (You may want to load this character in the Motion Editor to see the graph more easily.)

Figure 76. soldier_action_graph character graph



In the diguy Properties panel, is a list of all the actions that this character has. The actions have been organized into transition groups. For example, all standing actions are part of the Standing group and all sitting actions are part of the Sitting group. The organizational

rationale for these groups is that the transition from any standing action to any sitting action is the same regardless of the small differences between different standing action or sitting actions.

If you look at the graph, you see brown lines running from the node that represents a group to the individual action nodes in that group.

Between groups, transitions are indicated by directional lines. So from standing to sitting, the transition is `stand_ready_to sit_ready`. Similarly, the transition from sitting to standing is shown as `sit_ready_to_stand_ready`.

In addition to showing the transitions between groups or individual nodes, but examining the graph you can identify nodes that do not have any transitions.

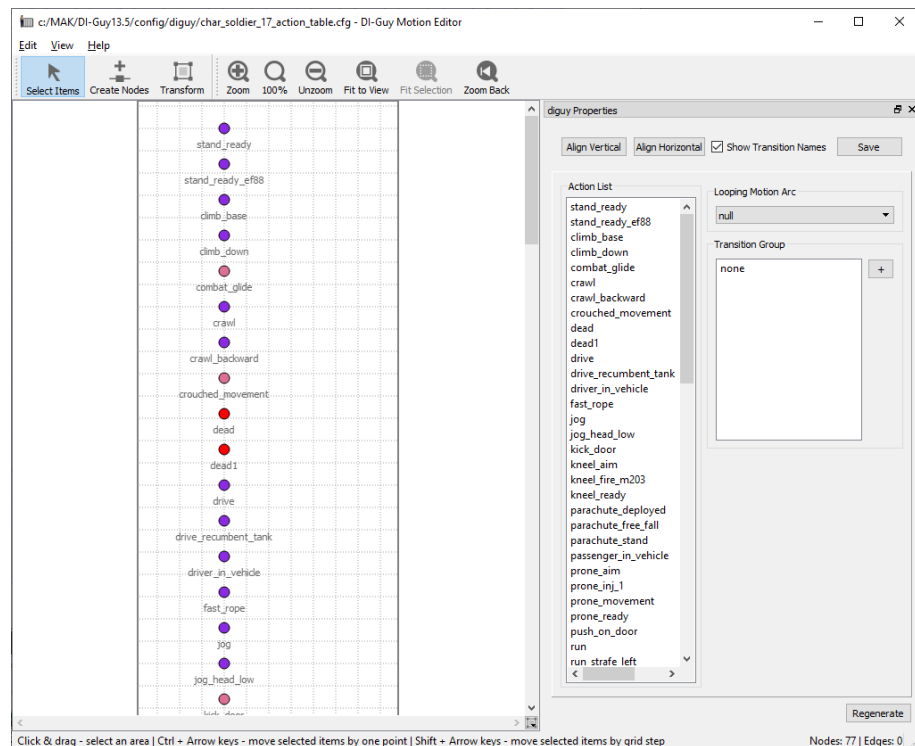
If you were to configure these transitions in a square table, you would have to individually specify the transition in each direction for each combination of sitting and standing actions. By grouping actions in the graph table, you can configure the transitions for all of these relationships in one action.

7.5.1 Displaying a Graph

► To display a graph table:

1. Open the Action Table Editor.
2. Select the Action Table tab.
3. Click Show Graph. A graph is displayed (Figure 77). It shows all actions in a vertical column of points.

Figure 77. New graph



4. Optionally, drag the action nodes around the graph.

7.5.2 Grouping Actions

The key to the utility of the graph table is to create transition groups of similar actions.

► **To create a group:**

1. Click the plus sign next to the Transition Group window. The New Transition Group dialog box opens.
2. Type a name for the new group. The name is added to the Transition Group list. A group node is added to the graph. It is not connected to any actions.
3. In the graph window drag a box around the actions that you want to be part of the group.
4. Click the name of the group in the Transition Group list. All of the selected actions are now connected to the group node.
5. Optionally, drag the group node to a sensible location in the graph, such as near the connected actions.

 When you select a group node, the diguy Properties panel redisplay to just show information about the group. When you select an action node, the Action List is displayed.

7.5.3 Removing a Node from a Group

Removing an action node from a group does not remove it from the list of available actions.

► **To remove an action from a group:**

1. In the graph, select the arrow that runs from the action to the group node. It changes color to indicate it has been selected.
2. Choose **Edit > Cut**. The arrow is removed. The action node remains in the graph.

7.5.4 Specifying Transitions Between Groups

Transitions are the movements that a character makes to go from one action to another, such as from standing to sitting. Smooth transitions make for life-like movement. In the graph table you can easily specify the transitions between group nodes.

► **To specify a transition:**

1. Select a group node. In the Properties panel, the Group Connections list shows nodes to which you can create a connection.
2. Select the group to which you want to connect the first node. An arrow is drawn between the groups.
3. Select the arrow. The Properties panel displays a list of motion arcs.
4. Select the motion arc you want the nodes in the group to use to transition to the second group.

i You can also create transitions between groups and actions and between individual actions that are not part of a group.

7.5.5 Converting to a Graph

If you change the type of an action table to a graph, if it previously was configured as a square table or columnar table, that configuration information is lost.

► To change to a graph table, in the Type list on the Action Table tab, select Graph.

7.6. Action Table Configuration Files

Action tables are stored in human-readable ASCII text configuration files. They are generated when you save the table and save the file. It is important for you to save these files in the correct directory location. DI-Guy scenario must be able to locate and load the tables during a DI-Guy session. The search order is as follows (assume character Foo):

1. Look in:

./custom/config/diguy/char_<Foo>_action_table.cfg

2. If the file is not found there, look in:

./custom/config/diguy/char_<Foo>_action_table.cfg

If you decide to hand-edit these files, be aware of the following rules:

- One-column action tables have N actions and N action table entries.
- Three-column action tables have N actions and 3*N action table entries. The entries are a series of three motions (pre, loop, post) for each action.
- Square action tables have N actions and N*N action table entries. Entry I,J defines the underlying blend motion from action I into action J, except when I equals J, when it instead defines the underlying looping motion of action I.



8. Editing Gestures and Gesture Tables

This chapter explains how to edit gesture tables and gestures.

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8.1. Gestures

A gesture is a motion that is applied to a sub-set of the DOF of a character during a particular action. Gestures extend the behavior of a DI-Guy character by piggy-backing extra body movement onto existing actions for a suite of character types. Gesture definitions describe which DOF they control and a weight value indicates how much the new DOF value should be blended with the existing DOF value. Weights set to 0.0 have no effect. Weights of 1.0 result in the gesture totally overriding the current value of a DOF. A typical example of a gesture would be a hand-wave, where the weights of the motion are non-zero for the waving arm only, and perhaps part of the back, because waving a hand only requires DI-Guy algorithms to take over one arm of a character, leaving the rest of the character's action unedited.

The DOF weights of a gesture table are constant and do not change from gesture to gesture. If different gestures require different weights, another gesture table is required.

The motion data for a gesture is the same as the motion data for an action, except that it only needs data for the joints used by the gesture. For example, if the gesture uses just the upper body, data for the lower body (hips, knees, and ankles) is not needed.

Most gestures have three motion arcs, one to initiate the gesture, a second that can be repeated many times to extend the gesture, and a third to terminate the gesture. The three motion arcs can be from the same motion file or from separate motion files.

Once you have motion data for the gesture, create a DI-Guy configuration file to define the gesture. For examples of how to define a gesture, look at *./config/gestures_wave.cfg*, which defines three different waving gestures. Name the file *autoload_gesture_<mnemonic>.cfg* and save it in folder *./custom/config*.

For example, imagine you need a gesture for stirring something. Create a motion file that has a character stirring, and save it as *brooks_stir.bdm*. Suppose that the data from 1.0 to 1.5 seconds brings the right hand up to begin stirring, from 1.5 to 2.5 seconds is one complete revolution of the whisk, and from 2.5 to 3.0 seconds withdraws the hand. Define the gesture as follows:

```
gesture stir_arm_r
  gesture_type = progression
  num_stages = 3
  num_channels = 1
  progression_stage1 = in
  progression_stage2 = loop
  progression_stage3 = out
  include common/gesture_variables_back_50.cfg
  include common/gesture_variables_head_50.cfg
  include common/gesture_variables_arm_r.cfg
  character_type = all

  motion_arc in
    datafile = brooks_stir.bdm
    tin = 1.000
    tout = 1.500
  motion_arc loop
    datafile = brooks_stir.bdm
```

```

tin = 1.500
tout = 2.500

motion_arc out
datafile = brooks_stir.bdm
tin = 2.500
tout = 3.000

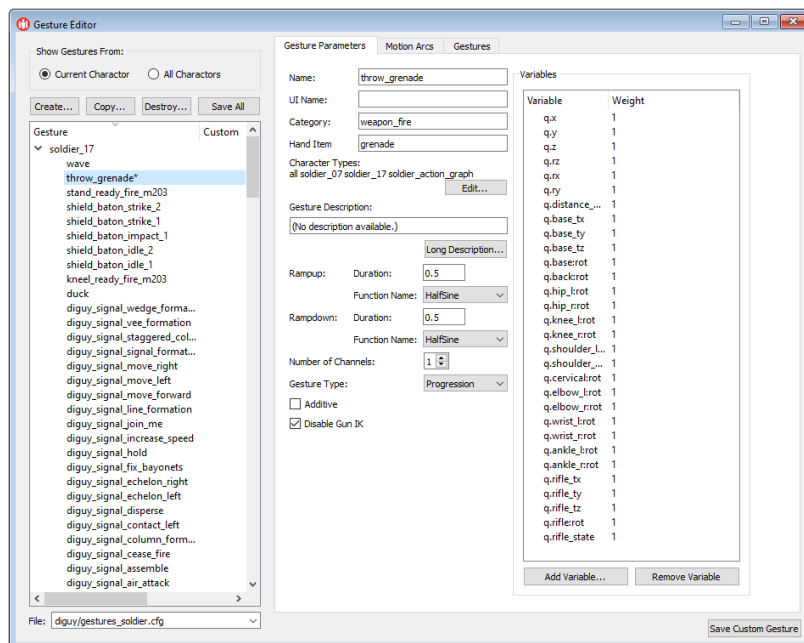
```

8.2. The Gesture Table Editor

The Gesture Table Editor (Figure 78) lets you create and edit gesture tables, and review, create, change, and extend gesture motions.

If a gesture table is suitable for a character, then all of the gestures are available to all of the actions defined by that character type. That is, the gesture table does not care about the action table at all (and vice versa). Rather, gesture compatibility requires only that the DOF names correspond for a motion and a character type. A character type's action and gesture table types are independent of each other.

Figure 78. The Gesture Table Editor



The Gesture Table Editor lets you:

- Discover all defined gestures (not only for the current character type, but for all character types).
- Edit or specify the gesture motion blend weights that each gesture DOF uses when a gesture is applied.
- Specify which character DOFs the gesture can affect.

- Set up a gesture table that specifies the underlying motions that are used to perform each gesture and specifies the transitional motions used to transition from one gesture to another gesture.

i When the Gesture Table Editor or the Action Table Editor are active, they take control of the 3D View. Otherwise, the Timeline window has control.

Not every DI-Guy character type has a gesture table or can use gestures. Standard character types have gestures, but unusual character types may not. Existing tables may be applicable to the active character type. You should inspect the variables (that is, DOF names) listed in the Gesture Parameters tab of the Gesture Table Editor to see if they match the variable names of the character.

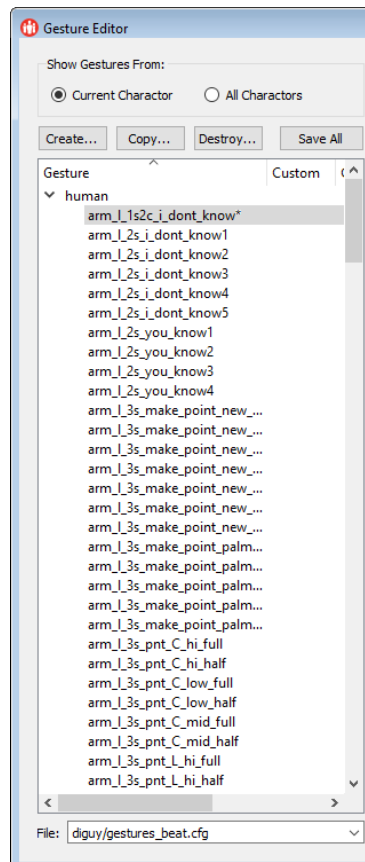
8.3. Opening the Gesture Table Editor

- To open the Gesture Table Editor, choose **Window > Gesture Table**.

8.4. Selecting a Gesture Table

The Gesture Table Editor lists all of the gestures and gesture tables that are available for a character or all characters (Figure 79). You can specify that it list gestures and gesture tables for the current character or all characters. You can specify that the list include gesture tables, all gestures in DI-Guy, or both.

Figure 79. Gestures and gesture tables list



- To list the gestures and gesture tables available for the current character only, in the Show Gesture From group box, select Current Character.
- To list the gestures and gesture tables available for all characters, in the Show Gesture From group box, select All Characters.
- To select the gesture table you want to edit, select it in the Gesture Tables list.

 If you just want to select gesture tables, clear the Gestures check box. This will filter out all the gestures and make it easier to find the gesture table you want. DI-Guy includes just one gesture table.

8.5. Creating a Gesture Table

By default, a new gesture table is accessible to all characters.

➤ **To create a gesture table:**

1. Click the Create button above the gestures and gesture tables list (Figure 79 on the previous page). The Motion Editor dialog box opens.
2. Type a name for the new table.
3. Click OK.

8.6. Copying a Gesture Table

If you want to create a gesture table that is similar to an existing one, the easiest thing to do is copy the existing table and then change the parameters that you want to be different. When you copy a gesture table, you must give it a unique name.

➤ **To copy a gesture table:**

1. Select the gesture table that you want to copy.
2. Click the Copy button above the gestures and gesture tables list (Figure 79 on the previous page). The Motion Editor dialog box opens.
3. Type a name for the new table.
4. Click OK.

8.7. Saving a Gesture Table

After you edit a gesture table, save the table.

➤ **To save an gesture table:**

1. In the Gesture Table Editor, click Save Table.
2. Choose **File > Save Gesture Table**.

8.8. Deleting a Gesture Table

► To delete a gesture table:

1. Select the gesture table that you want to delete.
2. Click the Destroy button above the gestures and gesture tables list (Figure 79 on page 126). You are prompted to confirm the action.
3. Click OK.

8.9. Editing Gesture Parameters

The Gesture Parameters tab (Figure 80) allows you to:

- Specify which characters have access to the gesture table.
- Provide a description of the table.
- Specify details regarding the nature of the blending that the gesture automatically performs.
- Specify the number of channels.
- Specify the gesture type.
- Specify the weight of gesture variables.

Figure 80. Gesture Parameters Tab

Variable	Weight
q.x	1
q.y	1
q.z	1
q.rz	1
q.rx	1
q.ry	1
q.distance_xyz	1
q.base_tx	1
q.base_ty	1
q.base_tz	1
q.baserot	1
q.backrot	1
q.hip_lrot	1
q.hip_rrot	1
q.knee_lrot	1
q.knee_rrot	1
q.shoulder_lrot	1
q.shoulder_rrot	1
q.cervicalrot	1
q.elbow_lrot	1
q.elbow_rrot	1
q.wrist_lrot	1
q.wrist_rrot	1
q.ankle_lrot	1
q.ankle_rrot	1
q.rifle_tx	1
q.rifle_ty	1
q.rifle_tz	1
q.rifle_rot	1
q.rifle_state	1
q.rifle_tx	1

The Gesture Parameters tab lists variable names (DOF) and the gesture DOF weights. A weight of 0 means the gesture does not affect a particular DOF whereas a weight of 1 means the gesture completely overrides the current DOF value. These weights can be edited by clicking on the text in the Weight column, and typing in a number. Additionally, variables can be added or deleted. If the weight is zero, you can delete that variable.

8.9.1 Adding a Gesture Description

You can provide a brief description of the gesture, which is visible on the Gesture Parameters tab and you can provide a longer description.

► **To add a description to a gesture:**

1. Select the gesture table or gesture for which you want to provide a description.
2. Select the Gesture Parameters tab.
3. Type the description in the Gesture Description box.
4. To provide a long description, click the Long Description button. The Edit Long Description dialog box opens.
5. Type the description in the window.
6. Click OK.

8.9.2 Specifying which Characters have Access to a Gesture Table

The Character Types field lists the characters that can use the gesture table. The effect of changing the character type is that the list of potential variables (DOF) that the gesture affects is culled to include only variable names useful to those characters.

► **To specify which characters have access to a gesture table:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. Click the Edit button next to the Character Types field. The Character Types Picker dialog box opens.
4. Select the characters that you want to be able to use this gesture table. You can select multiple characters. Note that one selection is "all".
5. Click OK. The characters types are listed in the Character Types field.

8.9.3 Specifying Blending Details

Rampup and rampdown determine the blend duration when the gesture is overlayed onto an action from the action table. The type of blend is determined from the function selected. These are the same functions described in "7.4.1 Displaying Motion Arc Extended Info" on page 112.

► **To specify blending details for a gesture:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. For the Rampup and Rampdown parameters, specify a duration, in seconds.
4. For the Rampup and Rampdown parameters, specify the type of blend by selecting an option in the Function Name list.

8.9.4 Specifying the Number of Channels

The number of channels indicates whether a single (default) or dual channel gesture is being used.

► **To specify the number of channels:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. Enter a value in the Number of Channels box.

8.9.5 Specifying the Gesture Type

► **To specify the gesture type:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. Select an option in the Gesture Type list.

8.9.6 Editing Variables

The Variables group box lists variable names (DOF) and the gesture DOF weights. A weight of 0 means the gesture does not affect a particular DOF. A weight of 1 means the gesture completely overrides the current DOF value. You can add and delete variables. If the weight is zero, you can delete that variable.

Adding a Variable

► **To add a variable:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. In the Variables group box, click Add Variable. The Variable Picker dialog box opens.
4. Select a variable in the list.
5. Click OK.

Specifying the Weight of a Variable

► **To specify the weight of a variable:**

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. In the Variables window, double-click the weight value for the variable you want to edit. It becomes editable.
4. Type a new weight between 0 and 1.
5. Click elsewhere in the window.

Deleting a Variable

► To delete a variable:

1. Select the gesture table or gesture you want to edit.
2. Select the Gesture Parameters tab.
3. In the Variables group box, select the variable you want to delete.
4. Click Remove Variable.

8.10. Motion Arcs Tab, Gestures Tab, Action Table Tab

If you are editing a gesture table, the Motion Arcs tab, Gestures tab, and Gesture Table tab are nearly identical in design and presentation to the tabs on the Action Table Editor. The difference is that the tabs in the Gesture Table Editor window specify the gesture table data instead of action table data. For general information about these tabs, based on the similarities to the Action Table Editor, see "Chapter 7. Editing Action Tables" on page 101.

The Gestures tab (Figure 78 on page 125) has one difference from the Actions tab of the Action Table Editor. The controls in the Exercise Gesture group box allow you to test the effect of Channel A weight changes (the value of which can vary from 0.0 to 1.0).

- **Begin Gesture.** Triggers the start of the gesture and lets it play until it reaches the loop part of the gesture (if the gesture loops), at which time the loop repeats indefinitely. If the gesture does not have a looping element, Begin Gesture plays the entire gesture once.
- **End Gesture.** Breaks the gesture out of its looping mode (if applicable) and allows the gesture to come to its natural end.
- **Channel A slider.** Specifies the weight of the gesture. This weight varies from 0.0 to 1.0 and determines how strongly the gesture overlays on top of an active motion arc.

If you are editing a gesture, the tabs change as follows:

- The Action Table tab is hidden. It is not meaningful for an individual gesture.
- The Gestures tab is largely unavailable, since most of the controls are meaningful for a gesture table, but not an individual gesture. You can still trigger a gesture.
- The Motion Arcs tab is mostly the same. The difference is the Motion Arcs list does not list gestures, since you select the gesture in the Gestures list.



9. Importing and Exporting Motions

This chapter explains how to export and import motions.

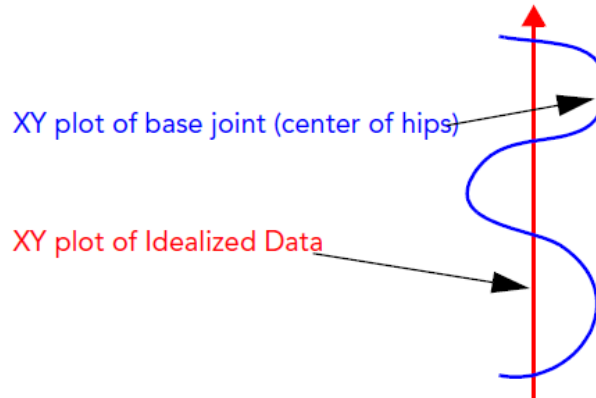
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9.1. Idealized Data

DI-Guy uses a concept called idealized data to help distill basic information about a motion. Idealized data allows the software to gain a higher-level understanding of the motion. The concept is best explained by an example.

Suppose that we are creating a motion called `drunken_walk`. In this motion, our character advances forward 1 meter, but while he does this he staggers from side to side. It looks like Figure 81.

Figure 81. X and Y translation of a drunken walk



The idealized motion of this character would be a straight line in the X direction that moves at a constant velocity. Meanwhile, the base link of the character is moving side to side as the character staggers up the street.

- This idealized information is represented in the motion (*.bdm*) file by the variables:
- `[q.x, q.y, q.z, q.rz, q.rx, q.ry]`
- The base information is represented in the same motion file by different variables specifying the transform from the idealized position to the final base (hip) position:

`[q.base_tx, q.base_ty, q.base_tz, q.base_rz, q.base_rx, q.base_ry]`

Thus the sum of the base transform and the idealized transform derives the true position of the hip in space.

i There is a third transform called offset, but this transform is only used internally by DI-Guy.

When playing a motion in the motion editor, the idealized variables `q.{x,y,z}` and `q.r{x,y,z}` are in the Joint Editor and can be edited and processed just like any other variable. However, editing these values is recommended for advanced users only. During motion export, DI-Guy automatically calculates idealized data.

9.2. Importing Motions from a Different Actor

If you import a motion into the Motion Editor that was created by a different actor and then export a DI-Guy motion from the Motion Editor Timeline, the current DI-Guy Actor is used to generate the idealized data, not the actor who actually performed the original motion, so you should let DI-Guy recompute idealized data during export, or otherwise edit it by hand. Visually inspect the motion in these circumstances, and use tools like the offset effect transition to repair any problems caused by actor mismatch.

9.3. Importing BVH Files

DI-Guy Motion Editor can import Bio-Vision Hierarchical (*.bvh*) files. These files are restricted to having skeletal hierarchies and joint names that match the current character of the Motion Editor.

The file *./motions/sample.bvh* is included in the distribution to aid you with constructing compatible BVH files.

► To import a BVH motion, select **File > Import > Motion or Pose**.

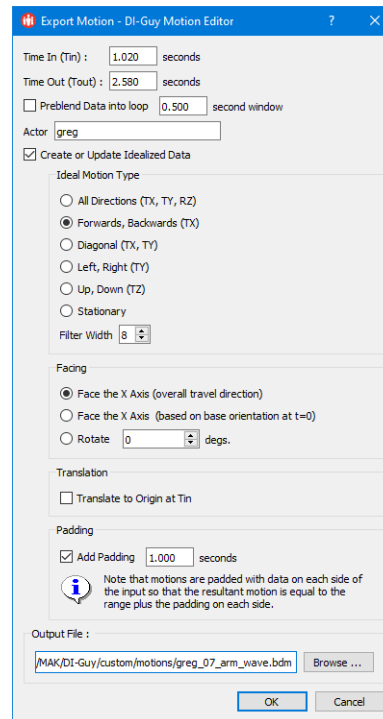
9.4. Exporting Motions

Motion exporting allows you to prepare the additional information that DI-Guy needs about a motion so that it can be used properly by the DI-Guy motion engine and the action table.

- To export the current contents of the Timeline as defined by the range selector (or all data, if the range selector is not shown):

1. Choose **File > Export > Motion**. The Export Motion dialog box opens (Figure 82).

Figure 82. Export Motion dialog box



1. Complete the fields of the dialog box. For more information, see "9.4.1 Creating or Updating Idealized Data" below.
2. Specify the output file. For more information, see "9.4.2 Specifying the Output File" on page 138.
3. Click OK.

i It is strongly recommended that exported motions allow for 1 second of padding on each side of the motion. For example, you might define a walk motion from a motion capture session of many steps. Instead of selecting a cycle starting at the first step, you should start the selection at a point in the timeline where there is a second of natural walking data to the left, and end the selection where there is still a second of motion data to the right. Having natural motion padding on each end results in better motion blending in the DI-Guy motion engine.

9.4.1 Creating or Updating Idealized Data

You will almost always want to create or update the idealized data when you export a motion that is to be used with DI-Guy.

- To create or update idealized data, select the Create or Update Idealized Data check box. Complete the dialog box as described in the following sections.

See "Chapter 7. Editing Action Tables" on page 101 for information about motion and facing direction.

Pre-blended Data

When a motion is exported, you can set it up so that the padding is pre-blended. Only advanced users should do this. Couple this selection with action table entries for the motion arc that indicate that the blend would be already blended.

- To preblend data, select the Preblend Data Into Loop check box.

Specifying the Ideal Motion Type

If you update or create idealized data, you must specify the ideal motion type.

Remember that idealized data is an idealized notion of how a character is moving. A character that is dancing, but ends up very near where the character started, should be classified as a stationary motion. Forward and backwards motions should face in the positive X direction.

- **To specify the ideal motion type, in the Ideal Motion Type group box, select one of the following options:**

- All directions. When the movement is a turning motion, such as turning to the left or right, select this option to ensure the rotation is applied correctly to the character. If you do not, the motion might not turn but instead reset back to forward facing after attempts to turn.
- A forwards/backwards motion. Movement straight ahead or backwards.
- Diagonal. Character move diagonally forward or backward.
- A left or right motion.
- An up or down motion.
- A stationary motion.

Specifying the Character Facing

The two Face X axis options rotate the character to face the X axis. These are considered the default options.

Any motions that have nonzero rotation on the base (hips) link of the character should be exported using the Rotate option in the Facing group box of the dialog box. If you do not select the Rotate option and specify the degrees, the export process adjusts the rotation of the character so that they face forward, effectively rotating the motion itself as well.

- To specify the facing direction, in the Facing group box, select the appropriate option.

Translation

When you select the Translate to Origin at T-in check box, this translates all of the motion data to set the beginning of the motion to line up with the world origin. If the motion is already at the origin, this should have no effect on the motion data. If the motion is not at the origin, the offset from the origin at the beginning of the motion is calculated and each data point in the motion updates such that any initial offset present on the motion is removed.

Padding

DI-Guy pads its motions, usually 1 second on each side, to enhance the appearance of motions as they are blended into actions by the DI-Guy motion engine. Padding should always be added to motions to achieve smooth action transitioning. You can specify a larger padding if the motion requires more time for the blend-in and blend-out to work well.

The Motion Editor tries to export as much data directly from the timeline as is possible to implement the padding. Extra padding data is generated automatically if the padding time extends past the end of data on the timeline. Suppose you have a 10 second motion on the timeline (the range selector spans from 0.000 to 10.000 seconds, with padding of 1 second). The exporter will export seconds 0-10 as the motion, but auto-generate an extra second of data on each end. This is not optimal. It would be better to use a motion that has real data on either side of the motion specified using the range selector.

► To specify padding:

1. In the Padding group box, select or clear the Add Padding check box.
2. If padding is enabled, specify the amount of padding in seconds.

9.4.2 Specifying the Output File

DI-Guy uses the file naming convention of: <actor_name>_<motion_descriptor> and recommends this convention to you. For example, gregg_run would be the name of the output file if the actor is named Gregg and the motion being created is a running motion.

After you click OK, DI-Guy:

1. Offers to preview the motion.
2. Asks which action tables the motion should be made available to.
3. Prompts for a motion arc name that will be used by the action table(s) for the character type being used.

DI-Guy uses the motion arc naming convention of: id_<actor_name>_<motion_descriptor> and recommends this convention to you. You can later change the motion arc name in the Action Table Editor. For more information about working with the new motion and motion arc, see "Chapter 7. Editing Action Tables" on page 101.

► To specify the output file:

1. In the Output File group box, click Browse. A file browser opens.
2. Type a name for the file.
3. Click Save.

9.4.3 Augmenting Export with Velocities

This preference forces the output of velocity variables along with the state variables during an export.

- To augment export with velocities, choose **File > Preferences > Augment Export with Velocities**.

9.4.4 Previewing Exported Motions

By default, DI-Guy Motion Editor previews motions when you export them. You can disable this behavior.

- To enable or disable previewing of exported motions, choose **File > Preferences > Automatically Preview Exported Motions**.

9.4.5 Specifying the Type of Exported Motion Files

You can specify whether exported motion files are binary or ASCII files. Binary files are smaller. ASCII files can be read in a text editor. The default is binary.

- To specify that exported files be in ASCII format, choose **File > Preferences > Output Text Datasets**.



10. Importing Motion Capture Data

You can purchase motion capture animations or capture it yourself. This chapter explains how to import motion capture data into DI-Guy.

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10.1. Importing Motion Capture Data into DI-Guy

One way to create realistic characters for DI-Guy is to use motion capture (mocap) technology to record movement and then process it for use by DI-Guy characters. This is a high-level overview of the procedure. It assumes you are familiar with 3DS Max and Autodesk Maya.

Many motion capture programs have the character facing the Y axis while the DI-Guy skeleton faces the X axis. This procedure helps you import motion capture data and apply it to the DI-Guy skeleton to ensure that the character is facing the correct direction.

1. In Maya, open `./geometry/maya/soldier_animated_by_mocap.mb.`. This file has the DI-Guy skeleton that has been rotated -90° (the X axis) and characterized (named "diguy_character" in the Human IK panel).
2. Import your mocap data into Maya. Characterize that skeleton. Retarget diguy_character to your new mocap character.
3. Adjust the mocap positioning:
 - a. Under Rigging, create a new joint at center of origin.
 - b. Zero out the translations.
 - c. Increase radius to 10 for visibility.
 - d. Freeze the transformations.
 - e. Drag the pelvis of the mocap character into this parent joint node.
 - f. Rotate the parent joint node Y by 90° .
4. Select the DI-Guy skeleton and, under Animation, bake the simulation. Depending on the length of your animation, this can take some time to process.
5. Export the DI-Guy skeleton as an *FBX* file (not a *DAE_FBX* file). If the export fails with a warning that there is nothing to export, you should save the file, close and restart Maya, and then try exporting again.
6. In 3DS Max, import the new *FBX* file.
7. Select the *FBX* file and then export it as a *DAE* file.
8. Import the *DAE* file into DI-Guy Motion Editor. The animation plays perfectly while the character faces the X axis.



11. Hot Keys

This chapter lists hot keys and keyboard shortcuts.

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Hot Keys List

Table 11 describes the hot key functionality of the Motion Editor. It is important to note which window needs to have focus when using a hot key, because some of them work only in certain windows.

Table 11. Hot keys

Key	Window/Scope	Description
Ctrl + O	Any/All	Open Project.
Ctrl + W	Any/All	Close Project.
Ctrl + S	Any/All	Save Project.
Ctrl + N	Any/All	Import Motion or Pose.
Ctrl + E	Any/All	Export Pose.
Ctrl + M	Any/All	Export Motion.
Ctrl + Q	Any/All	Quit Motion Editor.
Ctrl + Z	Any/All	Undo.
Ctrl + Y	Any/All	Redo.
Ctrl + X	Any/All	Cut.
Ctrl + C	Any/All	Copy.
Ctrl + V	Any/All	Paste.
Delete	Any/All	Delete (deletes from the timeline).
Ctrl + D	Any/All	Open/Close 3D View.
Ctrl + P	Any/All	Open/Close Project window.
Ctrl + T	Any/All	Open/Close Timeline window.
Ctrl + I	Any/All	Open/Close Info window.
Ctrl + J	Any/All	Open/Close Joint Editor window.
Ctrl + L	Any/All	Open/Close Log window.
Ctrl + K	Any/All	Open/Close Camera dialog box.
Ctrl + H	Any/All	Open a Help window.
Ctrl + A	Any/All	Open/Close the Action window.
Ctrl + G	Any/All	Open/Close the Gesture window.
L	Any/All	Clears the Log window.
Shift + L	Any/All	Run Limits report (to log window.)
Ctrl + U	Any/All	Import Audio.
Ctrl + R	Any/All	Open the Joint Limits dialog box.
<	Any/All	Decreases the timeline playback speed.
>	Any/All	Increases the timeline playback speed.
Home or O	Any/All	Jump time to beginning of timeline.

Table 11. Hot keys (continued)

Key	Window/Scope	Description
End or Shift + O	Any/All	Jump time to end of timeline.
[(open bracket) or Page Up	Any/All	Move time left one frame.
] (close bracket) or Page Down	Any/All	Move time right one frame.
P	Any/All	Toggle forward playing of timeline (resume/pause).
Shift + P	Any/All	Toggles reverse playing of timeline (resume/pause).
A	Any/All	Toggle all audio tracks on/off.
0 through 9	Any, Camera mode	Activate camera 1 through 10.
Ctrl +0 through 9	Any, Camera mode	Save the current camera settings to the index.
+	3D, Pose Editor	Increase rotation, or translation value (single DOF only).
-	3D, Pose Editor	Decrease rotation or translation value (single DOF only).
Space	3D, Pose Editor	Toggle DOF.
F1	3D, IK mode	Increase mouse sensitivity for edits.
+	3D, Camera mode	Increase translation time factor.
-	3D, Camera mode	Decrease translation time factor.
F	3D, Camera mode	Set camera to forward mode (if mover is FLY, and not focusing on a character).
S	3D, Camera mode	Set camera to sideways mode (if mover is FLY, and not focusing on a character).
D	3D, Camera mode	Set camera to vertical mode (if mover is FLY, and not focusing on a character).
	Timeline	Zooms in (changes time scale).
	Timeline	Zooms out (changes time scale).
Ctrl + ←	Timeline	Scroll timeline horizontally left.
Ctrl + →	Timeline	Scroll timeline horizontally right.
U	Timeline	Update the Joint Limit Compliance Track.
Space	Timeline	Toggle Snap-to.



DI-Guy Glossary

This glossary defines terms as they are used in DI-Guy.

A

action bead

An action bead appears as a yellow crosshair located on a path. Each action bead identifies an action that a character performs when it reaches the position of the action bead on the path.

actor

The flesh-and-blood actor whose performance was captured using motion capture. Motion files reference the original actor. The DI-Guy motion engine often performs mathematics to scale motions to fit the end dimensions of the virtual character's appearance.

aim bead

Sets the azimuth and elevation of an aiming character's weapon.

appearance

The specific geometry and textures that describe the visual look of the character. DI-Guy appearances can be skinned (deformable mesh) or segmented (rigid interpenetrated polyhedral). Many skinned appearances include equipment that may be segmented.

B

bead

A graphical symbol marker associated with a character and a path. Beads can be positioned anywhere along a path, but cannot leave the path. DI-Guy Scenario has action beads, aim beads, decision beads, gaze beads, motion beads, and signal beads.

C**camera**

Cameras control the 3D view of the scenario. Each virtual camera has a position and an orientation just as physical cameras do for a motion picture.

chain

A set of continuous joint-link DOFs that do not branch. Thus, the set of the three DOFs of the left thigh of a character could be considered a single chain, while the set of DOFs for both thighs would have to be considered two chains. Chains are used by Inverse Kinematics.

channel

A Motion Track consists of three channels, the A, B, and T channels. The A and B channels can have motions, poses, and trajectories loaded into them. The T channel can have transitions.

character

A human entity, vehicle, or prop in the simulated scenario. Each character has an appearance, a repertoire of behavior, and at least one path.

character_type

The combination of the set of actions a character can perform with the set of visual appearances the character can use.

D**decision bead**

A place on a path where a character's next action is contingent on signals in the scenario or signals initiated by the user.

degree-of-freedom (DOF)

Joints in the model of the character can be described by the number and type of DOFs of which they are composed. For example, a pin joint contains a single degree-of-freedom joint where the joint can rotate about one axis. The base joint is a 6DOF joint; it describes a position that requires 6 degrees-of-freedom to specify it (X, Y, Z, YAW, ROLL, and PITCH)

DOF

See degree-of-freedom.

E**entity**

A person, vehicle, or prop in the simulated scenario. A character.

G**gaze bead**

Sets the azimuth and elevation of a person's gaze.

J**joint**

Describes the way two rigid links are joined together. Popular joints include pin, frozen, 6DOF (degrees-of-freedom), ball, 3DOF, and slider.

joint group asset (JGA)

Every Motion Track contains a JGA. The JGA features a picture of the model with a Boolean value for every DOF in the model. These are used to indicate which DOFs are to be affected by the Motion Track

L**link**

A joint plus an offset. Often shapes are associated with links. Links can be traversed and drawn. Sometimes links are referred to as "bones".

M**motion**

A set of one or more frames of data. Each frame of data specifies the value for every DOF (Degree of Freedom) in the model. Motions containing two or more frames of data also have a DT value that specifies the amount of time between two frames of consecutive data. A motion has a time duration of $(N-1) \times DT$ seconds, where N is the number of frames in the motion. A motion that has only one frame of data is also called a pose.

motion track

A horizontal bar in the Motion Editor Timeline consisting of a head and a body into which motions, poses, and transitions can be loaded. Each motion track has a joint group asset associated with it. Tracks can be combined in the Motion Editor to create complex motions.

P**path**

Spline-shaped functions defined by waypoints. Characters travel along paths to move through scenarios.

person

A human entity in the simulated scenario. Each person has an appearance, a repertoire of behavior, and at least one path.

pose

A motion that has only one frame of data. A pose has a duration of zero seconds.

project

The highest level of data organization in the Motion Editor. It describes the complete state of the Timeline and thus preserves all the information needed to fully describe how the new motion being created. A project file (.mep file) is the text file that describes a project.

R**runtime pose**

A pose that does not have an independent external file representing it. Runtime pose information is stored in memory when a project is loaded or if a new project is being edited. Runtime poses are stored directly in the Motion Editor Project File (*.mep*) when a project is saved. A runtime pose can be exported to create a pose asset.

S**script bead**

A place on a path where execution of a Lua script is triggered.

sensor region

A 3D region that is sensitive to the presence of a person or vehicle. Each time a character enters or leaves a sensor region, an event is generated. Events are available as signals to other entities.

shape

A mesh or polyhedral associated with a link. Unlike the link, which is conceptual in nature, shapes are actual drawables.

shaperset

A collection of one or more shapes.

signal

A communication event that can influence the behavior of people in a scenario. For example, one team might provide a signal when it has completed a task so another team can begin a second task at the right time. Signals can be triggered by characters in a scenario or manually by a user.

T**trajectory**

An asset that can be constructed on the timeline that holds a series of trajectory atoms.

trajectory atom

One of the repeated components of a trajectory. The six values [X, Y, Z, Yaw, Roll, and Pitch] that completely specify the position and orientation of an object in space are held in each atom. The sequence of atoms determines the path of the end-effector of the link through time.

V**variable**

An object used to communicate with outside processes through the DI-Guy API.

W**waypoint**

Graphical elements that define paths. Each waypoint has a position, an orientation, and weighting factors that determine how much the waypoint affects the shape of the path.



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