



DI-Guy Expressive Faces 12.5
USER GUIDE

DI-Guy Expressive Faces
Version 12.5

Copyright © 2013 Boston Dynamics

Boston Dynamics
78 Fourth Avenue
Waltham, MA 02451 USA

For questions regarding *DI-Guy Expressive Faces*,
send email to diguy@diguy.com.

Information in this document is subject to change without notice and does not represent a commitment on the part of Boston Dynamics. The software described in this document is furnished under a license agreement or nondisclosure agreement. The software may be used or copied only in accordance with the terms of the agreement. It is against the law to copy this software in any fashion or on any medium except as specifically allowed in the license or nondisclosure agreement. No part of this document may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without prior written consent of Boston Dynamics.

FaceFX. ©2002-2013, OC3 Entertainment, Inc

Part No. DI-Guy 12.5 Expressive Faces Guide

DI-Guy Software License Agreement

This is a legally binding agreement between you (“LICENSEE”) and Boston Dynamics, with its principal place of business at 78 Fourth Avenue Waltham, MA USA (“Boston Dynamics”). By breaking the seal on the package containing the DI-Guy products (DI-Guy SDK, DI-Guy Scenario, DI-Guy AI and DI-Guy Motion Editor), and/or by installing and/or using the enclosed software, data, models, documentation, or related recorded information, regardless of its form or the method of the recording (the “SOFTWARE”), LICENSEE is agreeing to be bound by the terms and conditions of this agreement, including the software license and disclaimer of software warranty below. Please read this document carefully before opening the package and using the SOFTWARE. If LICENSEE does not agree with the terms and conditions of this agreement, LICENSEE should promptly return the unopened package and the SOFTWARE to the place where it was obtained, and LICENSEE will be given a full refund of any license fee that LICENSEE paid.

1. Grant of License: Subject to the terms and conditions of this Agreement, Boston Dynamics hereby grants to LICENSEE a non-transferable and non-exclusive right to use and execute the SOFTWARE on a single computer system at one time. LICENSEE agrees that it will not reverse engineer, decompile or disassemble any portion of the SOFTWARE, nor extract data of any kind from the SOFTWARE, including but not limited to motion data, 3D models, textures, texture movies, image sequences, terrain databases and the like. If LICENSEE disposes of any media or apparatus containing SOFTWARE, LICENSEE will ensure that it has completely erased or otherwise destroyed any SOFTWARE contained on such media or stored in such apparatus. LICENSEE may not distribute, lease, transfer, export, loan or otherwise convey the SOFTWARE or any portion thereof to anyone.

2. Copying Restrictions: In order to effect LICENSEE's license rights hereunder, it may install the SOFTWARE by copying it onto the hard disk drive or into the CPU memory of a computer system for use thereon, and may make full or partial copies of the SOFTWARE, but only as necessary for backup or archival purposes. LICENSEE agrees that (i) LICENSEE's use and possession of such copies shall be solely under the terms and conditions of this Agreement, and (ii) LICENSEE shall place the same proprietary and copyright notices and legends on all such copies as included by Boston Dynamics on the media containing the authorized copy of the SOFTWARE originally provided by Boston Dynamics.

3. Ownership: LICENSEE agrees and acknowledges that Boston Dynamics transfers no ownership interest in the SOFTWARE, in the intellectual property in SOFTWARE, nor in any SOFTWARE copy to LICENSEE under this Agreement or otherwise, and that Boston Dynamics and its licensors reserve all rights not expressly granted hereunder. After LICENSEE pays any applicable license fees, LICENSEE will own the media on which the SOFTWARE was originally provided hereunder and on which LICENSEE subsequently copies the SOFTWARE, but Boston Dynamics and its licensors shall retain ownership of all SOFTWARE and copies of the SOFTWARE or portions thereof embodied in or on any media.

4. Transfer Restrictions: LICENSEE may not sublicense, transfer, or assign this Agreement or any rights or obligations under this Agreement, in whole or in part.

5. Export Restrictions: LICENSEE agrees not to export or re-export, directly or indirectly, from the United States through any country or to any country of ultimate destination defined by the United States Government or any agency thereof as an “Excluded Territory”. LICENSEE will not export, directly or indirectly, the Licensed Programs or Documentation to any country from which the United States Government or any agency thereof requires an export license or other governmental approval at the time of export without first obtaining such license or approval. The U.S. Government's list of “Excluded Territories” is subject to change without notice and is therefore not included herein.

6. Confidentiality: By accepting this license, you acknowledge that the SOFTWARE and accompanying materials, and any proprietary information contained in the media, are proprietary in nature and contain valuable confidential information developed or acquired at great expense. You agree not to disclose to others or utilize such trade secrets or proprietary information except as provide herein.

7. Enforcement of Terms: If LICENSEE fails to fulfill any of its obligations under this Agreement, Boston Dynamics and/or its licensors may pursue all available legal remedies to enforce this Agreement, and Boston Dynamics may, at any time after LICENSEE's default of this Agreement, terminate this Agreement and all licenses and rights granted under this Agreement. LICENSEE agrees that Boston Dynamics' licensors referenced in the SOFTWARE are third-party beneficiaries of this Agreement, and may enforce this Agreement as it relates to their intellectual property. LICENSEE further agrees that, if Boston Dynamics terminates this Agreement for default, LICENSEE will, within ten (10) days after any such termination, deliver to Boston Dynamics or render unusable all SOFTWARE originally provided hereunder and any copies thereof embodied in any medium.

8. Governing Law: This Agreement shall be governed by and interpreted in accordance with the laws of the Commonwealth of Massachusetts, excluding its choice of law rules.

9. U.S. GOVERNMENT PURCHASES: If SOFTWARE is acquired for or on behalf of the U.S. Government, then:

- a. It is recognized and agreed that the SOFTWARE: (i) was developed at private expense; (ii) was not required to be originated or developed under a Government contract; (iii) was not generated as a necessary part of performing a Government contract; and (iv) was not accomplished during and necessary for the performance of a Government contract.
- b. It is recognized and agreed that SOFTWARE is commercial computer software, as that term is used in FAR Parts 12 and 27.4 (and any applicable agency supplements thereto), and DFARS Parts 211.70, 227.4 (OCT 1988), 227.71 (JUN 1995) and 227.72 (JUN 1995).
- c. If this purchase is subject to FAR Part 27, and FAR 52.227-19 has been incorporated into the terms of this purchase, the Government's rights in the SOFTWARE are no greater than RESTRICTED RIGHTS as specified in FAR 52.227-19.
- d. If this purchase is subject to DFARS Part 227 (OCT 1988), the Government's rights in the SOFTWARE are no greater than RESTRICTED RIGHTS as specified in DFARS 252.227-7013(c)(1)(i).
- e. The Government's rights in the SOFTWARE are no greater than the rights expressly stated in the body of this Standard Licensing Agreement, if this purchase is subject to (i) FAR Part 12; (ii) FAR Part 27, and FAR 52.227-19 has not been incorporated into the terms of this purchase; (iii) DFARS Part 211.70; (iv) DFARS Parts 227.71 and 227.72 (JUN 1995); or (v) any other regulation or clause permitting the contractor to deliver commercial computer software under the contractor's standard commercial license.
- f. Any related technical data shall be delivered to the Government with no more than limited rights.

10. DISCLAIMER OF SOFTWARE WARRANTY:

BOSTON DYNAMICS PROVIDES THE SOFTWARE TO LICENSEE "AS IS" AND WITHOUT WARRANTY OF ANY KIND, EXPRESS, IMPLIED OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR WITH RESPECT TO INTELLECTUAL PROPERTY OWNERSHIP, NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY ANY BOSTON DYNAMICS EMPLOYEE, REPRESENTATIVE OR DISTRIBUTOR WILL CREATE A WARRANTY FOR THE SOFTWARE, AND LICENSEE MAY NOT RELY ON ANY SUCH INFORMATION OR ADVICE.

11. Limited Warranty on Media: Boston Dynamics warrants the media on which SOFTWARE is recorded and provided to LICENSEE under this Agreement to be free from defects in materials and workmanship under normal use for a period of ninety (90) days after the date of the original delivery of SOFTWARE to LICENSEE. Such warranty is solely for LICENSEE's benefit and LICENSEE has no authority to assign, pass through or transfer this warranty to any other person or entity. If LICENSEE returns any defective media to Boston Dynamics or an authorized Boston Dynamics representative during the warranty period with proof of purchase, Boston Dynamics will, at its sole option, either replace such defective media or refund the purchase

price for such media. This warranty will not apply to any media that has been damaged by abuse, accident or misuse. The foregoing warranty sets forth Boston Dynamics' entire liability and LICENSEE's exclusive remedy for any defects in any media and is in lieu of, and Boston Dynamics disclaims, all other warranties, express, implied, or otherwise, including without limitation any warranty of merchantability or fitness for a particular purpose.

12. LIMITATION OF LIABILITY: IN NO EVENT SHALL BOSTON DYNAMICS OR ITS LICENSORS BE LIABLE TO LICENSEE FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL OR INDIRECT DAMAGES OF ANY KIND (INCLUDING WITHOUT LIMITATION THE COST OF COVER, DAMAGES ARISING FROM LOSS OF DATA, USE, PROFITS OR GOODWILL, OR PROPERTY DAMAGE), WHETHER OR NOT BOSTON DYNAMICS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSS, HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY ARISING OUT OF THIS AGREEMENT. THESE LIMITATIONS SHALL APPLY NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. BOSTON DYNAMICS' LIABILITY ARISING OUT OF THIS SOFTWARE LICENSE AGREEMENT AND/OR LICENSEE'S USE OR POSSESSION OF THE SOFTWARE, INCLUDING WITHOUT LIMITATION ANY AND ALL CLAIMS COMBINED, WILL NOT EXCEED THE AMOUNT OF THE LICENSE FEE LICENSEE PAID FOR THE SOFTWARE PROVIDED UNDER THIS AGREEMENT.

13. Laws Governing Warranties and Liability: The law(s) of a jurisdiction may define the scope of warranty to be provided for products or the manner in which a supplier's liability may be limited, and such law(s) shall govern this Agreement only to the extent a party protected by such law(s) cannot waive the protection thereof by contract. In the U.S. and other countries, some states, territories or other principalities do not allow the limitation or exclusion of liability for incidental or consequential damages, or allow the exclusion of implied warranties, so the limitation and exclusion above may not apply to LICENSEE, and LICENSEE may have other rights that vary from state, territory or principality to state, territory or principality.

DI-Guy Expressive Faces User Guide - Table of Contents

INTRODUCTION	4
1. HOW TO WORK WITH DI-GUY EXPRESSIVE FACES	8
STEP ONE: CREATE A SCRIPT.....	9
STEP TWO: SELECT AN AVATAR	10
STEP THREE: SELECT A TERRAIN, PROPS, AND BACKGROUND CHARACTERS -- AND PREPARE A BASE SCENARIO	12
RECORD VOICE PERFORMANCES.....	12
STEP FOUR: CREATE LIP-SYNCING ANIMATIONS IN FACEFX STUDIO PROFESSIONAL	13
STEP FIVE: CREATE A SIMPLE LOCAL PATH FOR EACH RESPONSE (ANIMATION)	17
2. CREATING A FACEFX HEAD APPEARANCE.....	20
CREATING AND EXPORTING DATA FROM 3DS MAX	20
SETTING UP AND PUBLISHING A NEW FACEFX ACTOR.....	21
SETTING UP A HEAD FOR USE IN DI-GUY	22
3. CUSTOMIZING SCENE OBJECTS, MOTIONS, TEXTURES, AND SOUNDS	25
A REMINDER ON DERIVATIVE WORK.....	25

Introduction

Welcome to the new DI-Guy Expressive Faces Guide!

DI-Guy is software for realistic human simulations. Standard DI-Guy characters have static faces and are often viewed from a far enough distance that this is a satisfactory visual result (and a win for high performance visualization).

DI-Guy Expressive Faces module enables users to enhance DI-Guy characters with expressive face geometry and therefore create more “intimate” performance with their characters including:

- faces that emote
- lips that sync to audio
- eyes that blink and gaze

DI-Guy Expressive Face users also tend to make heavier use of some standard features of DI-Guy such as gesturing, pointing, and gazing.

DI-Guy Expressive Faces are the perfect solution for simulations where communicating with other human characters is critical and characters are close to the camera. DI-Guy Expressive Faces have been used for:

- Interrogation Training for Criminal Investigators
- Cultural Training
- Use-of-Force Training

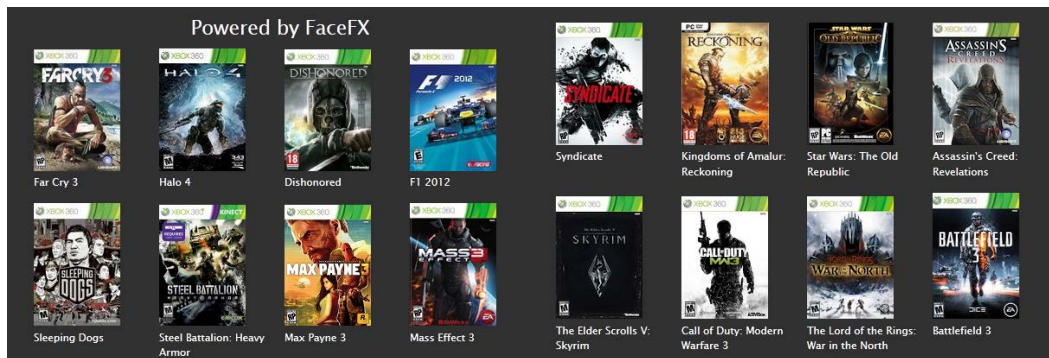
Developers will often couple speech recognition technology with DI-Guy Expressive Face characters to communicate naturally and have conversations with their lifelike Expressive Faces avatars. The avatars in turn often have sophisticated branching logic and performances that allow the avatar to react intelligently to questions, building on previous questions, etc.

DI-Guy is proud to announce with version 12.0 that OC3’s FaceFX software underpins DI-Guy Expressive Faces. This new partnership ushers in a renewed era for DI-Guy Expressive Faces. While there are many reasons DI-Guy has switched to FaceFX with DI-Guy 12.0, some of the biggest reasons include:

- The FaceFX Studio Professional application. This software enables users, via its powerful user interface, to create lip-syncing and other expressive performances. The user interface lets users edit graphs for all sorts of parameters for facial animation, such as blink, eye brow raise, head tilt, etc., with a timeline-based editor that lets the user tune the performance. FaceFX Studio Professional comes as part of the DI-Guy Expressive Faces Development license.



- DI-Guy can now offer Expressive Faces support on multiple operating systems and interface to the DI-Guy Graphics API.
- FaceFX is a popular choice in the video game industry. Like DI-Guy, OC3 is investing in the continuous upgrade of FaceFX, so that users who choose DI-Guy Expressive Faces are guaranteed that their investment will keep pace with the ever-advancing changes in human and facial simulation.



The DI-Guy Product Line

DI-Guy Expressive Faces can be used with all of the DI-Guy product line, an integrated set of human simulation products. Members of the DI-Guy Product Line are designed to work together seamlessly:

The DI-Guy SDK – embed DI-Guy in your real-time application and populate your world with lifelike human characters. With the Expressive Faces option, DI-Guy SDK offers a rich API giving users unprecedented control of the entire human performance, from overall body posture and motion, to gestures and facial animation.

DI-Guy Scenario – author and visualize human performances in a rich, user-friendly graphical environment. Use DI-Guy Scenario as an end visualization application or save scenarios and load them into your DI-Guy SDK enabled application. DI-Guy Scenario works with Expressive Faces to make authoring easy, particularly for creating whole body behavior and adding gestures to performances.

DI-Guy AI – generate crowds of autonomous characters to quickly populate your worlds with hundreds and thousands of terrain-aware, collision avoiding DI-Guys. Used as a module on top of DI-Guy Scenario and DI-Guy SDK.

DI-Guy Motion Editor – create or customize motions to your particular needs in an easy-to-use graphical application.

Networking Module – broadcast and receive DI-Guy characters using DIS or HLA. (DI-Guy Scenario only – note that DI-Guy SDK is also routinely networked, see the DI-Guy SDK User Guide on networking to find out how)

Special Effects – use an extremely versatile and customizable particle-based system to create smoke, fire, water, weather, explosions, dust trails, and other special effects. (DI-Guy Scenario only - free)

For more information about the DI-Guy Product Line, go to www.diguy.com or email us at diguy@diguy.com or sales@diguy.com.

Documentation

DI-Guy comes with lots of documentation on how to use DI-Guy:

- o **DI-Guy SDK User Guide** – How to program using the DI-Guy SDK
- o **DI-Guy SDK Reference Manual** – All the functions and classes of DI-Guy SDK
- o **DI-Guy Scenario User Guide** – How to use DI-Guy Scenario
- o **DI-Guy Content Guide** – Images of DI-Guy Content and Customization Guide
- o **DI-Guy AI User Guide** – How to use DI-Guy AI
- o **DI-Guy Motion Editor User Guide** – How to import, edit, and customize DI-Guy motions
- o **DI-Guy for Vega Prime** – How to use DI-Guy with Vega Prime
- o **DI-Guy Digest** – XML-based file that explains DI-Guy content to non-DI-Guy applications
- o **DI-Guy Expressive Faces** – faces that emote, lip-sync, with eyes that blink and gaze

DI-Guy Conventions

Note the following coordinate system conventions used within DI-Guy:

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

1. How to work with DI-Guy Expressive Faces

There are many ways to work with DI-Guy Expressive Faces. Should one use a DI-Guy AI Hierarchical Finite State Machine (HFSM) to control logic? Will users (typically trainees) be interacting with the avatar? Via speech? Via a button-pushing user interface?

This document will not attempt to address all possible modes of using DI-Guy Expressive Faces (although the author strongly encourages developers to experiment and push the boundaries of how Expressive Faces can be used). Instead, this document will attempt to describe a technique, hereafter referred to as the *Expressive Local Paths Technique* that has been successful with users, in-house developers, and the author. The goal here is to get you quickly developing using DI-Guy Expressive Faces.

Developers are recommended to use simple nomenclature for files and other assets when working with DI-Guy Expressive Faces. If possible, non-alphanumeric characters, dashes, spaces, etc., should be avoided.

The Expressive Local Paths technique assumes:

- The scenario to be created will be interactive between a user (hereafter referred to as the *trainee*) and one or more DI-Guy characters equipped with DI-Guy Expressive Faces (hereafter referred to as *avatars*).
- The basic progression of the scenario occurs via a repeated succession of a question asked by the trainee and a response returned by the avatar. Occasionally actions performed by the trainee such as drawing a weapon will also influence avatar behavior.
- Responses to a particular question or action may be variable and will be affected by what questions or actions have previously occurred in the simulation.

The following steps summarize the Expressive Local Path Technique:

1. Create a script
2. Select an avatar(s)
3. Select a terrain, props, and background characters and prepare a base scenario
4. Record voice performances
5. Create lipsyncing animations in FaceFX Studio Professional
6. Create a simple Path for each avatar response
7. Create signals and a pushbutton interface for signaling questions to the avatar

8. Create an Expressive Local Path for each avatar response by adding gesture, gaze, and actions to the Simple Local Path
9. Build up logic for how the avatar chooses a response
10. Create and train a vocabulary for accepting speech from the trainee and translating it into a signal

In the following sections, we will examine each step in detail.

Step One: Create a script

The first step to creating your performance is to think long and hard about your goals for the simulation and how those can best be achieved. Is your application training the trainee on how to ask certain questions, or perform a particular task? How can your scenario most effectively get at this core education? Is the scenario meant primarily to train, demonstrate, or test? Also, how can you “ring fence” the simulation. It will not be possible to have your avatar respond to any question. You will have to fit your development to the goals and the budget you have for authoring.

For our Expressive Faces demonstration in this document, we have chosen to create a simple interrogation scene. Our goals are two-fold:

- 1) Demonstrate DI-Guy Expressive Faces in a convincing manner to increase customer confidence and
- 2) Create a demonstration useful for a tutorial.

The following sub-goals became evident:

- Create a simulation likely to be applicable to customer/prospect needs.
- Demonstrate a wide range of emotion for the avatar.
- Demonstrate logic that shows that previous questions affect future responses.
- Create a simulation that can be run in 2-3 minutes, that makes it tractable as a tutorial but also can be demonstrated in a trade show environment.
- Given the wide range of the potential audience, choose subject matter that is not too uncomfortable.



The following burglary interrogation script, described below, satisfies all the above criteria. Note that this initial script differs from the final demonstration scenario included in the distribution of DI-Guy – like all scripts, it undergoes changes as voice actors and developers acting as Directors make modifications during the process of simulation creation. Also note that the author is not trained in interrogation technique, this is a purely fictitious scenario intended for demonstration purposes. Finally, note that there are two answers to most of the questions; this is because these questions can be asked twice.

Sample Burglary Interrogation Script

0? Can we ask you some questions, [Miranda rights],
 - *No, it's ok, I've got nothing to hide. I don't even know what this is about. (friendly)*

1? What is your name?
 - *My name's Timothy Johnson, you can call me Tim (smile)*
 - *I already told you, my name's Tim...*

2? Where were you last night?
 - *Last night I was with my buddy Johnny, you know, having a few beers. (laughs) We watched TV at his house all night. (happy)*
 - *Yea, like I was telling you, I was with my pal Johnny. That guy's the greatest. We watched the baseball game all night at his place."*

3? Really? We arrested your friend Pete Kenny last night for burglary, and he said you were driving the car... [establishing witness]
 - *I don't believe you. (disgust) I was with Johnny last night.*
 - *Why would Pete say that? (disgust)*

4? Do you know that an officer was shot last night? [establishing guilt]
 - *What? Really? (confusion) I...I didn't know that.*
 - *I understand, that's terrible. (sympathy, empathy)*

5? Listen Tim, we're here to help, we just want to know what happened. [establishing trust]
 - *I dunno...I was with Johnny last night. (confusion, weakness)*
 - *Listen, I didn't do it, but if I did, it would have been for the money, not to hurt anybody!*

Once 3,4,5 have been asked at least once, and perhaps forcing 2 of 3 of the questions to be asked twice, he then confesses.

"Alright, listen, I did it, it was a stupid idea. Pete put me up to it. I didn't want anyone to get hurt. That was Pete!....I think I should get a lawyer. "

Step Two: Select an avatar

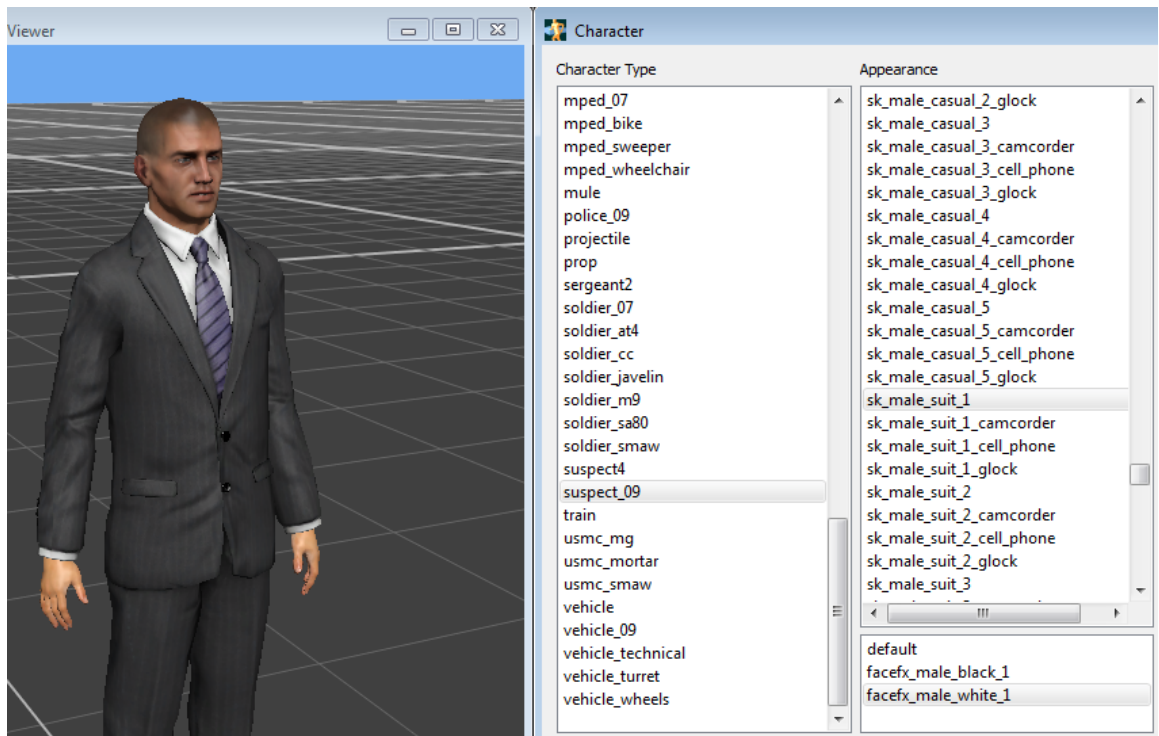
Selecting the best starting avatar involves three things:

1. Selecting the best start DI-Guy Character Type

2. Selecting the best body appearance
3. Selecting the best facial appearance

Activate the DI-Guy Character Viewer from the Start Menu. DI-Guy Character Viewer lets you audition all of the content that comes with DI-Guy (and if you have created any custom content, that will be visible here as well).

You want to choose the best DI-Guy Character Type, which means generally the Character Type that has the most actions similar to what you are looking for in your performance. The “suspect_09” Character Type is a particularly rich Character Type that has many interesting actions relevant to simulations that



might need facial animation.

You’ll then of course want to find the best appearance for the body and the best facial appearance as well. Use the Appearances column to select different body appearances. Not all appearances have corresponding expressive face appearances. Those that do will see a secondary appearance list under the main appearance list where one or more expressive face appearances are listed.

IF YOU CANNOT FIND THE RIGHT COMBINATION of Character Type, Appearance, and Facial Appearance, please contact DI-Guy Support at diguy@diguy.com for assistance. Because version 12 marks the introduction of FaceFX-style expressive faces, there are only a small number of sample faces

available to certain appearances. Let us work with you to get you the character type / appearance / facial appearance that will let you be successful.

DI-Guy is fully customizable, so if there are additional motions, character appearances, or facial appearances required, these can be added by the Developer. Again, contact diguy@diguy.com for assistance with facial customization, while consulting the DI-Guy Content Guide for customizing character appearances and the DI-Guy Motion Editor Guide for instructions on customizing actions for DI-Guy.

DI-Guy Services can also be engaged to create these customizations, as well as building a starting scenario or other assistance.

Step Three: Select a Terrain, Props, and Background Characters -- and prepare a base scenario

Start up DI-Guy Scenario¹.

Choose a scene object (terrain) from DI-Guy's available scene objects (Centennial Hall, Convention Center, Default Stage 11, Desert, Jailhouse, Khost Afghanistan, Middle East Town, Rocktown, Neighborhood, Ocean, Park, Penn Station, Railroad Crossing, Sadr City, Sunnyvale suburb, or Urban Street) or a scene object (.flt format) that you supply.

Determine where you would like your avatar(s) to be located, blitz in a character of the Character Type and appearances decided in Step Two and choose one or more interesting camera angles to help bring the performance to life.

Browse the many vehicles and props available with DI-Guy and place them in your scene.

If there are any supporting characters, consider blitzing them in to begin to populate the world.

Note for all the above steps users may choose to create custom geometry or engage DI-Guy Services to create engaging and realistic backdrops, props, vehicles, and support characters.

Record Voice Performances

This step is simple and yet very important². The quality of the voice recordings will be a major factor in the believability of your end performance. Two factors are important. The first is the technical quality of the recording. Use a quality microphone. Have post-processing tools that at a minimum allow you to crop audio recordings, reduce noise, and can output .wav files. The second important factor is the performance quality of the recording. Choose a voice actor carefully that has a voice that matches your avatar and is not a distraction. Be sure that the voice actor not only has a fine voice but can emote and act convincingly.

¹ The use of DI-Guy Scenario is recommended but not required for implementing Expressive Faces.

Developers choosing not to use DI-Guy Scenario need to perform these operations using their own tools.

² Advanced Developers may consider using speech generation for their avatar. Contact diguy@diguy.com for support and advice.

When producing the vocal performance, give strong direction to the actor to assure you get the voice capture that will make your scenario successful.

Finally, consider video recording the performance to assist with later steps where the facial animation will be emotively tuned in Studio Professional and DI-Guy Scenario to help bring the performance to life. Larger budget programs can even consider performing a motion capture session to live capture skilled actor performances for reproduction in the simulation.

Final .wav files should be placed in the %DIGUY%/custom/sfx/<recording session name> directory. Consider using descriptive filenames and perhaps including the actor's name in the filename.

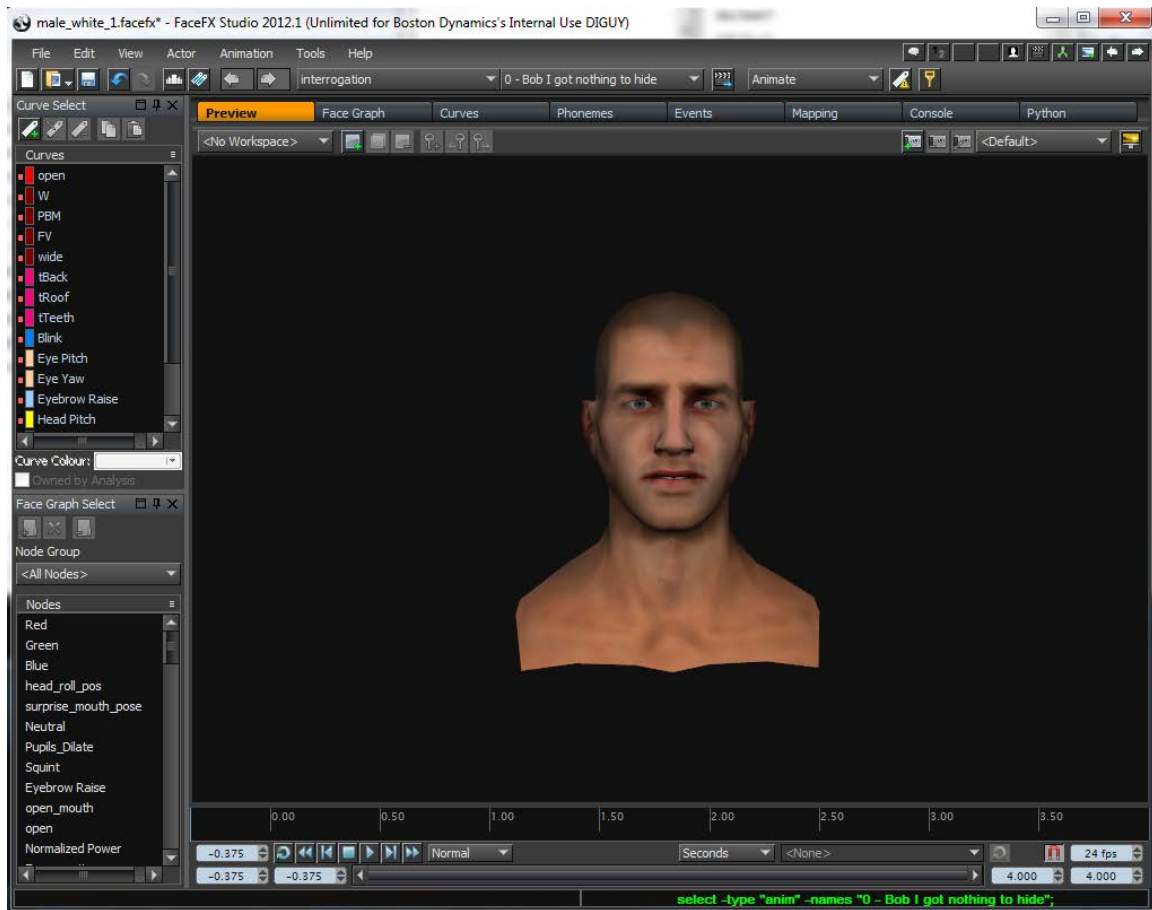
Step Four: Create Lip-Syncing Animations in FaceFX Studio Professional

Start up FaceFX Studio Professional from the Start Menu.

Choose File->Open Actor. Available actors are found in the %DIGUY%/geometry/facefx directory. These files have a .facefx suffix. You do not need to create a custom file.

You should now be able to see the target face graphically. Use the <ALT> button to mouse the camera view to a satisfying pose for animation.

You now need to generate a new animation group for the actor. Select Actor->Animation Manager and then New Group. Choose a name for your animation group. We'll be using "interrogation".



Now let's load a sound file for lip syncing. Select "Animation->Create Animation. Note that you should have your new animation group selected in the selection box. If you don't it's ok because you can move animations into different animation groups later using the Animation Manager. In the dialog box, select "Create an animation from an audio file". Browse to find one of your .wav files previously saved in %DIGUY%/custom/sfx/<recording session name>, select it and choose Next. The dialog box will now prompt you for the exact words of what the wave file says. Enter that dialog and select Next and then Next again, using the default Language and Analysis Actor File. The dialog will prompt you with an animation name derived from the wave file name. Select Finish.

Go to the play controller and select Play (the triangle button immediately to the right of the square icon'd Stop button). You should see the character speak the text you've entered.

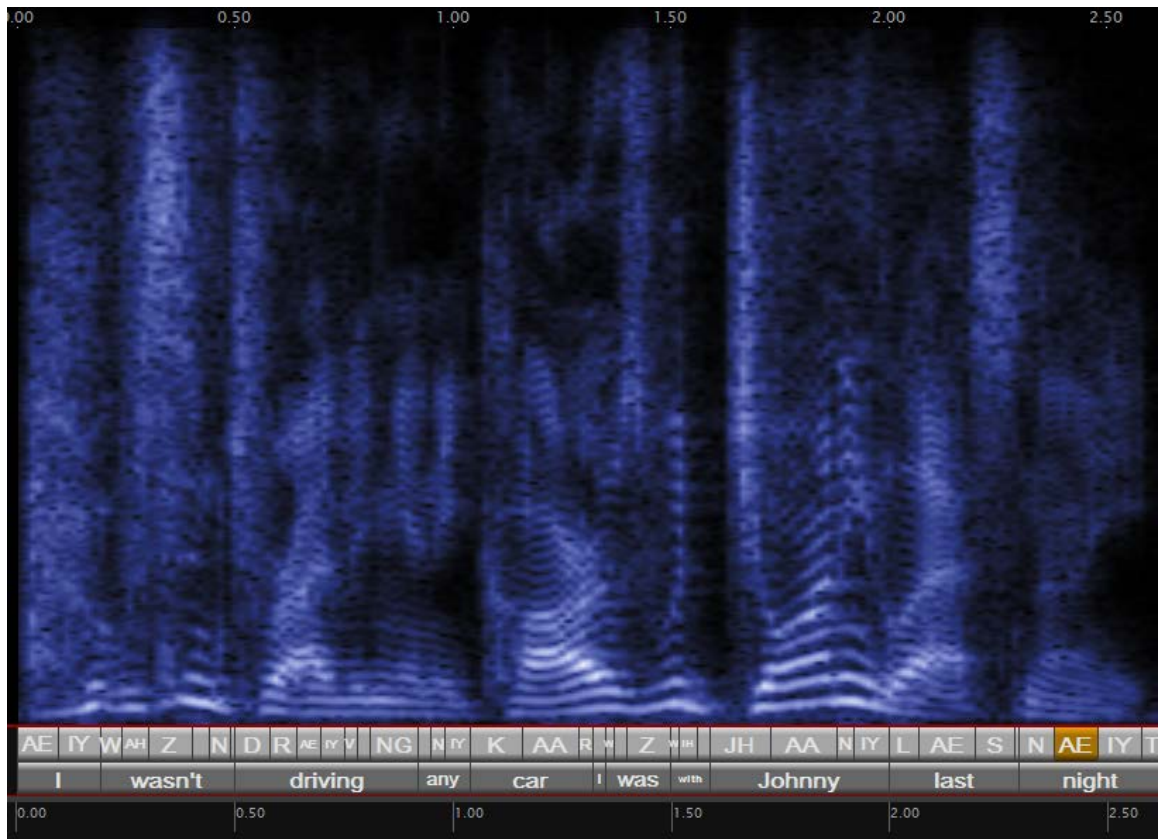
You'll notice that the character will not only perform the lip syncing, but other facial animation will be created by the system, attempting to get you started on a convincing performance. These may include various head tilts, eye brow motions, and blinks. If you're lucky, the performance as-is may be satisfactory and you can consider publishing the animation and testing it in DI-Guy.

However, you will typically want to improve the performance. The FaceFX Studio Professional has a wealth of features for directly editing the performance. This reader is encouraged to learn more about FaceFX Studio Professional from OC3's documentation, but the following sections will attempt to demonstrate some basic tools this author used to refine the performance.

Refine the Lip-Syncing

This author's first step to refining the performance is to examine the lip-syncing in detail. If I don't believe that the character's mouth is truly speaking the phonemes I hear, then the quality of the rest of the performance doesn't matter.

Select the Phonemes tab, you should see something similar to the image below:

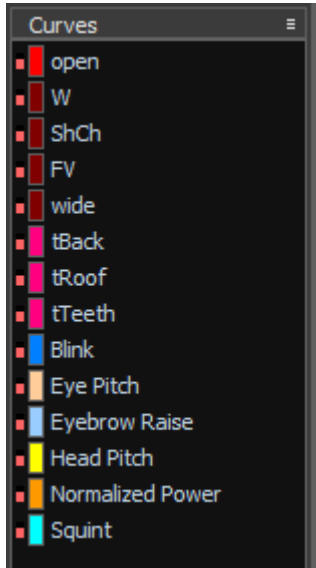


The top of the window represents the actual audio wave. The third row shows the actual text that you entered when you created the animation. The phoneme breakdown of that sentence as matched to the actual audio wave is shown in the 2nd row. Finally, timing in seconds is shown along the top and bottom of the screen.

I often found that I wanted a particular phoneme to start earlier, so I would spend time translating a problem phonemes to the left, or adjust its width. Simply click and drag on the phonemes to re-arrange. Go back and forth between this tab window and the Preview tab window. Try playing the performance at quarter time by changing the Normal pulldown on the playback controller to Very Slow. While the voice will be much deeper, it is much easier at this speed to see and correct lip-syncing timing issues.

Besides moving phonemes, you can insert or delete phonemes. Another important change can be to close the mouth during pauses. We'll examine how to do this in the next section.

Curve Editing



If you look to the left of the screen, you will see a curves section with a number of parameters listed. Let's take a look at "open" which controls how far open the mouth is. Select open and then select the Curves tab.



You should see a graph of the "open" curve similar to the above. You will notice in the bottom of the Curves section a checkbox called "Owned by Analysis". Unselect this checkbox if you would like to edit the performance. You can move the control points up, down, or even laterally in the curve editor. You can add new control points.



Let's examine another important curve, "blink". In the wav file I was processing, the character blinked twice at the end of the phrase but did not blink at all in the beginning. I added a early blink at the start of the phrase.

Two other curves which add lots of expression are “eyebrow raise” and “squint”.

I next look at curves such as Head Yaw, Head Pitch, and Head Roll. The overall movement of the head can really help with creating a convincing performance. As FaceFX’s analysis did not spawn any head movement for my .wav file, I need to add those curves (the green ‘+’ icon below Curve Select).

Obviously, working with these parameters in FaceFX is where technology meets art. The variation you can add to your performance is infinite. If you have made video recordings of your actor, you can watch those videos and duplicate the facial animations you liked the best.

Saving and Publishing Your Work

Save your actor and animation set when you are happy with the new animations you have made.

Saving the actor is straight-forward. If this is the first time, you need to also save (export) the animation set, select Actor -> Export Animation Set. Save the Animation set to %DIGUY%/custom/sfx/<your project name>/<character name>. For my demo I called the project name “interrogation” and the character name “suspect”. Once you have done this, the Export Animation Set will be grayed out and the update of the animation set happens automatically during actor save or game publishing.

Your last step is then to “Publish to Game”. Select File->Publish to Game. You will see a dialogue box appear. Set the Output directory to be %DIGUY%/custom/sfx/<your project_name> and leave the default checkboxes.

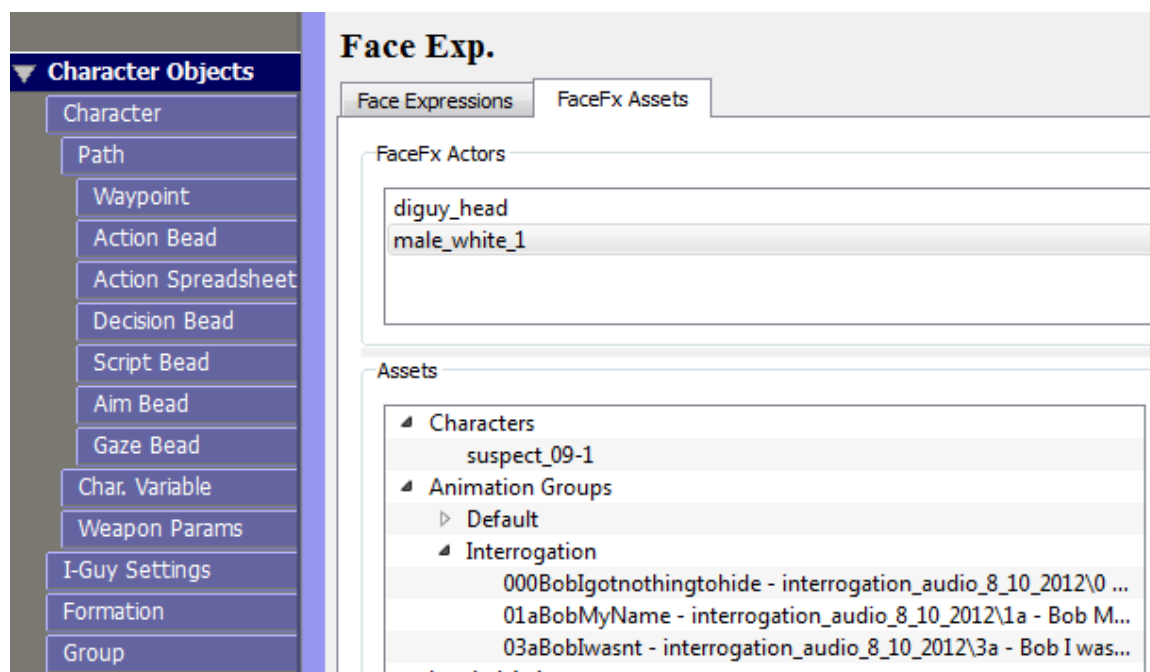
Reopening Your Work

When you want to do some more work, Start FaceFX Studio Professional, then File->Open Actor where you choose the same actor as before. Then select “Actor->Mount Animset” to retrieve your older animations.

Step Five: Create a simple local path for each response (animation)

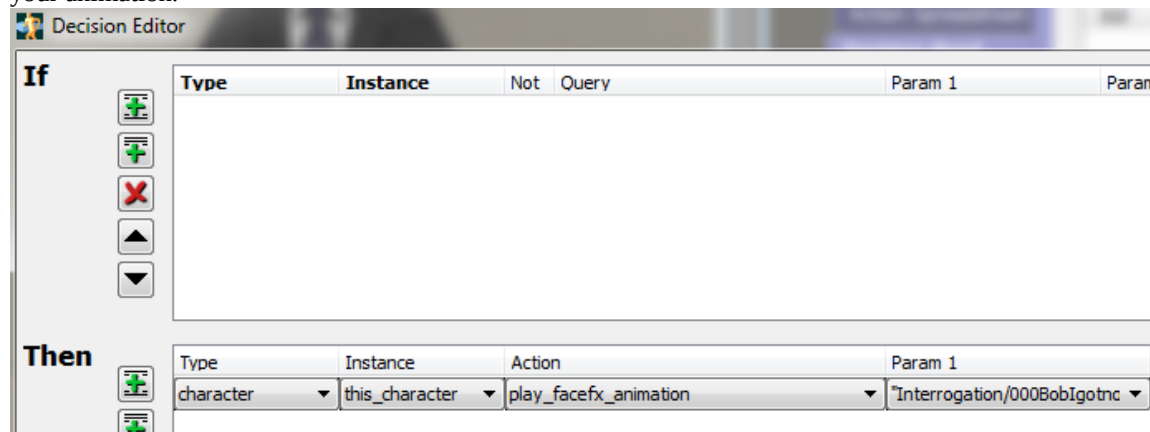
Start up DI-Guy Scenario and load the scenario you created during Step Three.

Open the Character Objects page and select the character for which you’ve made the animations. Select the Face Exp. Tab and then the FaceFx Assets tab on that palette. Select your FaceFx Actor in the top window, then Add Animset, and find the animset you saved in Step Four. Audition the animations you created by expanding the appropriate entry in “Animation Groups” and then double-clicking on the animation(s) stored in it. In the image below, the Interrogation animation set has three animations stored in it.



Notice that at the bottom of the FaceFx Assets tab there is a “Reload All Actors” button. This button is very useful. If you like, you can keep your FaceFX Studio Professional session running from Step Four, and as you modify or add animations, once you’ve saved those changes, *you do not need to restart DI-Guy Scenario to use those changes, just click the button.*

Now let's create a path for each animation. Since my first animation is called 000BobIgotnothingtohide, I'll select Character Objects->Path, select “Create”, and change the name from “path1” to “000Igotnothingtohide”. Select the Decision Bead tab and add the following sort of information to play your animation.



To audition the path, go to the Character Objects->Character path and make this path be the Initial Path. Select the play button. Note that you may want to alter the character's action to be "sit" or "stand" on the path, as it will default to "walk".

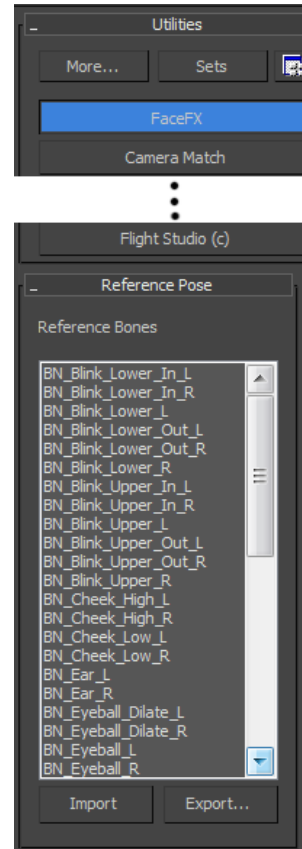
Once you've done this, on the Path tab select Create Copy for each animation you created. This author encourages you to set the "Path Paste Offset" to 0, 0, 0 in the Edit->Preferences pulldown menu so that each new copy is in the exact same place. Update the new paths with better names and point the decision bead entries at the appropriate animation.

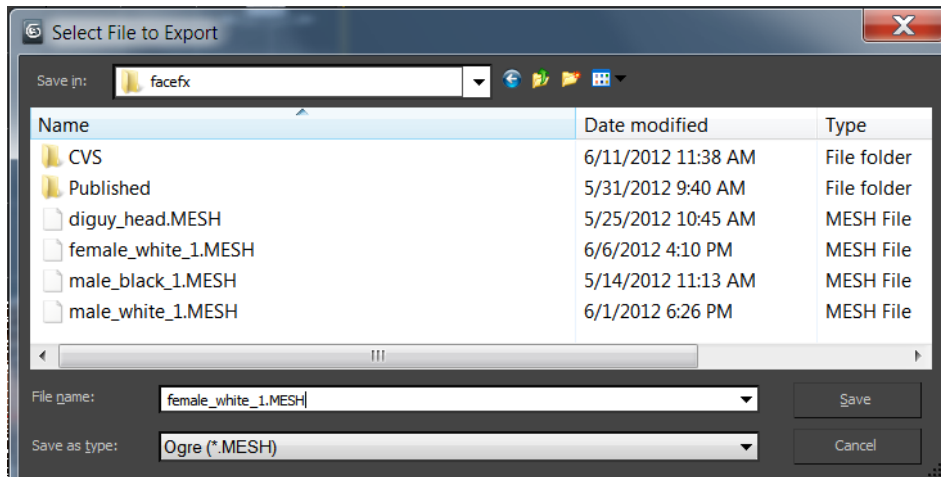
We now have one or more simple paths, but they are not local. Making these paths be local means that when the path starts, it will begin where the last path left off. This is useful when stringing paths together, the last thing you want is a discontinuity when a new path is activated.

2. Creating a FaceFX Head Appearance

Creating and Exporting Data from 3DS Max

- Start with a sample facefx model found in \$DIGUY/geometry/facefx there should be a number of .max files to use as a base.
- Modify Geometry, textures etc. We recommend using the skin wrap modifier if you need to do any significant changes to vertex topology. The wrap modifier allows you to reference a second model and copy its weights by proximity.
- Verify that the character can go through all the emotions and poses in the animation data.
- Pick the FaceFX utility plug-in (see image) Click **Create Actor** and give the character a reasonable name that will match the associated head appearance.
- Click **Export** on the Reference Bones panel and select all bones with the BN_ prefix.
- Click **Batch Export...** on the Nodes Panel pick the following script that has a list of poses and the keyframes they happen at \$DIGUY/geometry /facefx/diguy_batch_export.txt
- Click **Save Actor** and place the new actor file in \$DIGUY/custom/geometry /facefx
- Select the head of the character and do the **Export Selected** command the file should be exported as a Ogre .Mesh file. Give it the same name as the actor and save the file in \$DIGUY/custom/geometry /facefx/





- Note: any change in the hierarchy of character bones or changes to the neutral pose will probably require that the actor is recreated. ***When in doubt go through the export process again.***
- Select the various mesh LODs of the character and ALL of the BN_joints and export them as a collada dae file into the \$DIGUY/custom/geometry/dae directory.

Setting Up and Publishing a New FaceFX Actor

- Load FaceFX Studio
- Open the actor file that was saved in \$DIGUY/custom/geometry/facefx
- You should now see a the face that was exported as an ogre mesh file.
- If you switch to the face graph view there will be a unstructured node graph that doesn't have constraints or connections. Select Actor>Sync to template and import \$DIGUY/geometry/facefx/diguy_head_face_graph.fxt this should now give you a character that can animate and lipsync to audio.
- Follow the FaceFX Studio manual on how to author animation and create animsets for use in DI-Guy
- Run the command File>Publish to Game and publish the new actor in \$DIGUY/custom/geometry/facefx/published

Setting up a head for use in DI-Guy

Example of a FaceFX shape set

```
shape_set facefx_male_w1
  actor = greg
  is_base_shape = 0
  class_type = head
  multi_lod_filename = facefx_male_w1.dae
  shape_attachment_data = head position facefx
  shape_suffix_lod1 = _lod1Mesh
  shape_suffix_lod2 = _lod1Mesh
  shape_suffix_lod3 = _lod1Mesh
  shape_suffix_lod4 = _lod2Mesh
  shape_suffix_lod5 = _lod2Mesh
  shape_suffix_lod6 = _lod2Mesh
  shape_suffix_lod7 =
  parameters
    facefx_actor = male_white_1
```

Special flags for a facefx head shape set:

- *class_type = head* - Indicates that this shape replaces other items with class type of head, without this the character will have 2 heads.
- *shape_attachment_data = head position facefx* – Indicates that the head mesh should be attached to the position link and be initialized with the facefx module shape callbacks
- *facefx_actor = male_white_1*– Indicates which facefx actor should be used when this shapeset is loaded

Example of a FaceFX head appearance

```
head_appearance facefx_male_white_1
  item = facefx_male_w1
  parameters
    head_type = male_large
    graphics_state_switch_map1 = sk_male_w1_hands:male_w1_head
```

Special flags for a facefx head appearance:

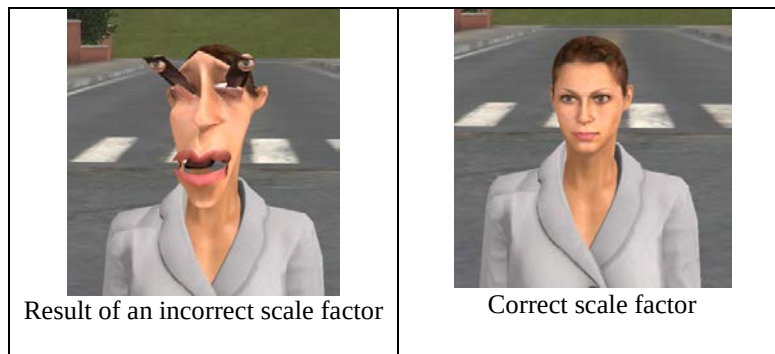
- *head_type = male_large* – indicates what body appearances this head is compatible with. Body appearances are also tagged with a head_type field to allow the user interface to only present the appropriate heads for a given appearance.

- *graphics_state_switch_map1 = sk_male_w1_hands:male_w1_head* – this state switch will apply to the characters hand item and keep the color of the hands in sync with the color of the head. This is applied after any state switches in the body appearance.

Note: the head appearance functionality isn't limited to FaceFX, non-facefx heads can be made swappable as well, the *shape_attachment_data* should just not specify "facefx"

Gotchas:

- DI-Guy uses a shader lookup table to establish a mapping between 3ds max bones and DI-Guy Links, the lookup table is specified in *\$DIGUY\config\common\shader_matrix_index_tables.cfg*. If you intend to use a different naming convention for your face bones you MUST add a new *shader_matrix_index_table* entry to a custom version of *shader_matrix_index_tables.cfg*.
- Number of Joints - we currently use a max of 50 link matrixes in shaders, if you intend to build a expressive face with more joints then 50 you will need to modify both the shaders and the *shader_matrix_index_tables*
- Scale mismatch between DI-Guy and FaceFX – the animation data that FaceFX produces is scaled by .0254 when mapped into DI-Guy's animation system, a few models have required a different value. It's been unclear where in a 3 application/2 file format -export-pipeline the problems arise. An illustration of the issue:



To fix this add a bit of meta data to *\$DIGUY\custom\config\diguy\facefx.cfg*

```
face_data female_white_1
  unit_conversion_factor = .01
```

- You may also need a stiff drink to counteract the fears of a bug-eyed alien invasion. Scaling of heads in Max is also very tricky, it may require scaling the *BN_Head* node, then disconnecting all children and scaling the bones back to a scale factor of <1.0,1.0,1.> and then renormalizing all scale keyframe data on the joints. And then reconnecting the hierarchy. After a mesh is scaled the mesh will need a *Reset XForm* modifier added above the mesh and below the skin and collapsed.

After changes to joint position it's usually nessassary to reset the skin by checking and unchecking **Always Deform** in the advanced section of the Skin Modifier.

3. Customizing scene objects, motions, textures, and sounds

Customizing scene objects

To add custom scene objects (terrains), copy the OpenFlight Format database to the **\$DIGUY/custom/geometry/sets** directory.

Customizing motion

You can customize motion using the *DI-Guy Motion Editor*. See the *DI-Guy Motion Editor User Guide* for details.

Customizing texture

To customize textures, edit an existing texture and save it with the same name in the **custom/geometry/rgb or custom/geometry/png** directory.

Textures use the Silicon Graphics RGB or RGBA or PNG format.

Note that you may want to instead create a new appearance that uses your new texture instead of overriding the existing appearance.

Customizing sound

To customize textures, edit an existing sound and save it with the same name in the **custom/sfx** directory.

You can also simply add new sounds to this directory.

A Reminder on Derivative Work

Any DI-Guy content (whether it be a model, texture, motion, etc) 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 *Boston Dynamics* to discuss licensing for other uses of derivative models.