

## **QUICK START: Introduction**

Digital MORPH is designed to be a simple, easy to understand image manipulation system. A few moments reading this Quick Start tutorial will get you up and running in a short time. Topics covered include system configuration, software installation, and how to do a basic morph, warp, and animation.

If you have been using Microsoft Windows, you will feel right at home with Digital MORPH since we use techniques standard to all Windows programs. Opening and saving files, choosing functions from the menu bar, moving graphics and windows, and On-Line Help will be just like other Windows application programs.

Even if you haven't been using Windows, learning Digital MORPH is still a breeze. There is no need to be intimidated anymore by software. The Windows environment makes using Digital MORPH productive and fun. A few minutes spent with the Windows tutorial found in the Program Manager will cover the basics, and you'll adapt quickly to using Digital MORPH.

If you need to set up or check your configuration, please read the next section for details.

## **QUICK START:Configuration**

### **Windows 3.1**

Digital MORPH requires that Windows 3.1 be installed and configured. You MUST upgrade 3.0 to 3.1! Digital MORPH will not execute under Windows 3.0.

It is critical that Windows is running in 386 Enhanced mode. To check whether you are in 386 Enhanced mode, go to the Program Manager and choose About Program Manager from the Help menu. If you are not in 386 Enhanced mode, you must change your Windows configuration. This setup is beyond the scope of this tutorial. Refer to your Windows documentation for more information.

### **Mouse**

Digital MORPH requires a mouse or compatible pointing device.

### **VGA Support**

Digital MORPH will support all video modes from Standard VGA (640x480x256 colors) through 24-bit (16.7 million colors) at any resolution. Consult your board's documentation and be sure that Windows recognizes the configuration. For optimal performance, a hi-color card is recommended.

### **System Memory**

Digital MORPH requires a minimum of 4 megabytes of memory. However, when using less than 8 megabytes, performance will be severely degraded, especially if using a hi-color VGA card.

It is recommended that at least 8 megabytes of memory be installed, and 16 (or more) megabytes would be even better. The program must keep at least three copies of an image in memory during normal operations, and sometimes four or more copies are required when morphing in Two Image mode. Usually each image requires about 1 megabyte of memory. In addition, disk caches, programs, and other Windows applications that you might have running also use memory.

## **Math Co-processor**

Due to the complexity of calculations involved, a computer with a 486DX processor is recommended. Computers with a 486DX processor and above have a math co-processor unit built into the chip itself.

If you are using a 386- or 486SX-based computer, installing a math co-processor will greatly enhance system performance.

## QUICK START:Installation

To Install Digital MORPH on Your Hard Disk

1. Start Windows.
2. Insert the Digital MORPH disk 1 in the disk drive of your PC.
3. Choose the Run command in the File menu of the Windows Program Manager.
4. Type A:Setup in the Command Line text box.
5. Choose OK.

The Digital MORPH Install program will guide you through the rest of the installation.

Drivers to play back .AVI files and Autodesk .FLC and .FLI files are included as part of the Digital MORPH installation. Digital MORPH saves animated morphs and warps using these file formats. You will need to restart Windows in order to load these drivers properly before using Digital MORPH.

During the installation process, you will be prompted to allow changes to your SYSTEM.INI and WIN.INI files. Backup files of your current SYSTEM.INI and WIN.INI will be created and saved in the Windows program directory. These files will have the extension .HSC; i.e., SYSTEM.HSC and WIN.HSC.

## QUICK START: Tutorial

This short tutorial will give you an introduction to Digital MORPH basics. Refer to the subsequent chapters in this manual for more details. You should be familiar with Windows terms and functionality before attempting to use Digital MORPH. A Windows tutorial can be found in the Program Manager's Help menu.

A menu selection instruction will appear in bold italics and is abbreviated, as in this example:

***File/Exit***

This means click on the menu item "File" which is found on the menu bar, then click on the drop down item "Exit." Multi-level menus are indicated as File/Open/Open Image. Click all three to execute the instruction.

1. To start Digital MORPH, double-click on the Digital MORPH icon found in the Digital MORPH Group.



## QUICK START Tutorial: Morphing

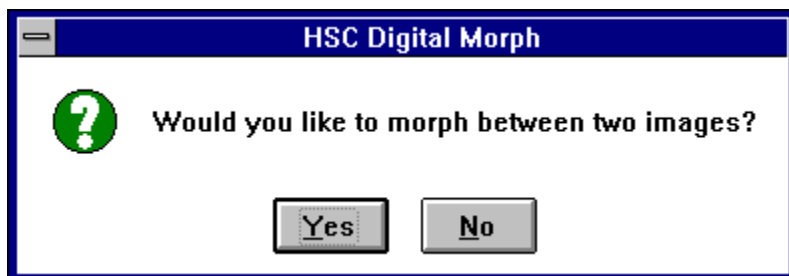
Morphing is a technique used to transform one image into another.

All morphs follow a basic procedure: define a source and destination image, then enter "field lines" on both images

to outline the common areas to be morphed. The two images are then animated to complete the morph.

1. Choose [File/New/New Morph](#). The "Open Image File" dialog box is presented to choose an image to morph.
2. Sample files for this tutorial are included in the Samples sub-directory. Double-click on the Samples sub-directory to display the list of sample files.
3. Select boy.bmp and click on OK. This image will be your source image (the image that will be morphed into something else).

At this point, a prompt is given to ask if you would like to morph between two images.



4. Click on Yes.

The "Open Image File" dialog box is presented once again.

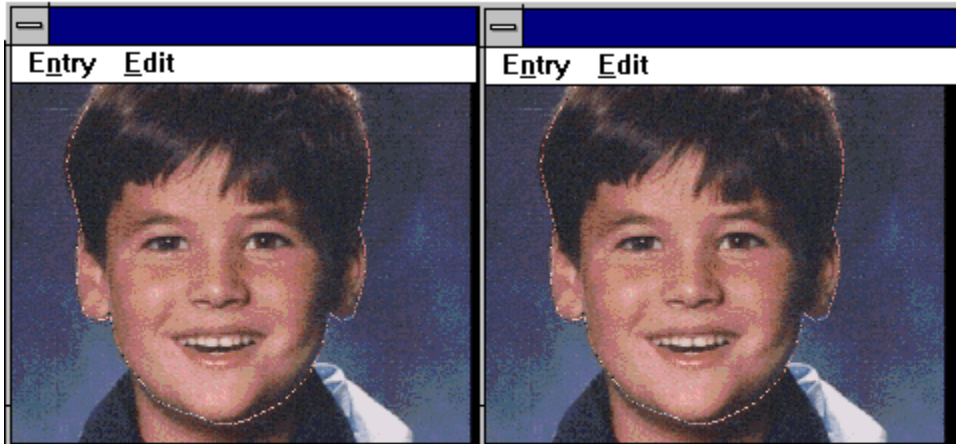
5. Select girl.bmp and click on OK. This is your destination image (the image that your source image will be morphed into).

When both images are opened, the "Morph Field Lines Entry" screen is presented showing the source image. Even though the destination image is open, you will not see it at this time. The cursor is now in the shape of a '+'.

Field Lines are used to match up common features between two images, e.g. eyes, nose, mouth, etc.. For the purpose of this tutorial, you will draw Field Lines around the face only.

6. Outline the face with Field Lines.

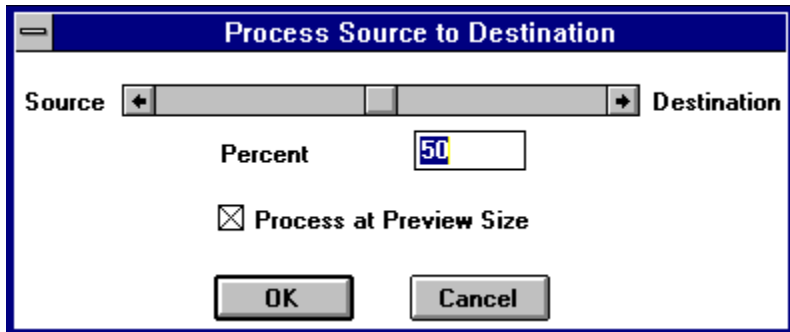
Outline an edge by clicking the left button at contour changes. For this example, do not enter more than a few points, just enough to follow the contour roughly.



7. When your outline is complete, choose [Edit/Penup](#) to designate the last point in the outline.
8. Choose [Entry/Save](#). You are now returned to the Digital MORPH working area. Both the Source and Destination images will now appear.
9. Double-click inside the Destination window, or choose [Morph/Edit Destination Field Lines](#). The Destination image will appear in the Working window.
10. Your goal here is to closely match the outline of the girl image (destination) to the outline of the boy image (source). You accomplish this by pressing and holding the left mouse button at one of the end points and then dragging the point to a new location. Drag as many points as necessary so that the girl's image is outlined in the same way as the boy's image.

11. Choose [Morph/do Morph](#).

The "Process Source to Destination" dialog box allows you to determine the degree to which the source image will be morphed into the destination image. For example, if you choose 50%, the result you see will be a morph that's about half source image and half destination image. You can choose to process the morph at 100% or anywhere in between the source and destination images.



12. Click OK to view the effect. The image will take several moments to process. The morph will appear in the Working window.



## Quick Start Tutorial : Saving Morphs

1. To save the current morph field lines, choose [File/Save As/Save Morph As...](#) and enter a filename.



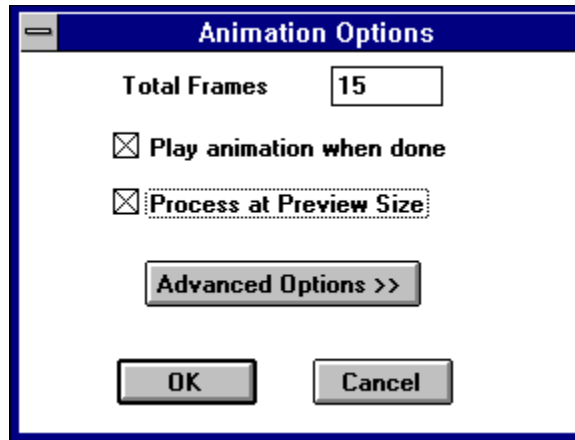
It is not necessary to enter the file's extension. The extension .FLD is added automatically to all morph field line files.

## Animating the Morph

You can add motion to a morph by animating it.

1. Choose [File/Animate/Animate Morph](#). Make sure that both "Play animation when done" and "Process at Preview Size" are enabled (with an X).





2. Enter the total number of frames to animate in the "Total Frames" box. For this example, fifteen frames will produce a good result.
3. Click OK. Each frame will be produced in turn.



Note that full image morphing can be a lengthy operation. Press the Esc key to terminate the process, if necessary.

4. When the processing is finished, the Media Player will appear. Click the play button to view the animation. Close the Media Player to return to Digital MORPH.

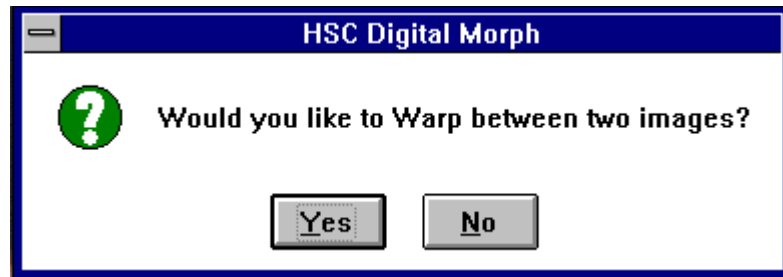
## Closing the Current File

1. Choose [File/Close](#). All images, field lines, and animations will be closed.

## QUICK START Tutorial: Warping

Warping is a technique using a grid-based system to distort an image. The following procedure will explain the basics of moving grid intersection points in order to create a warp, followed by instructions on how to animate the warp.

1. Choose [File/New/New Warp](#). The "File Selection" dialog box is presented to choose an image to warp.
2. Select boy.bmp from the Samples sub-directory and click OK. A prompt is given to ask if you would like to warp between two images.

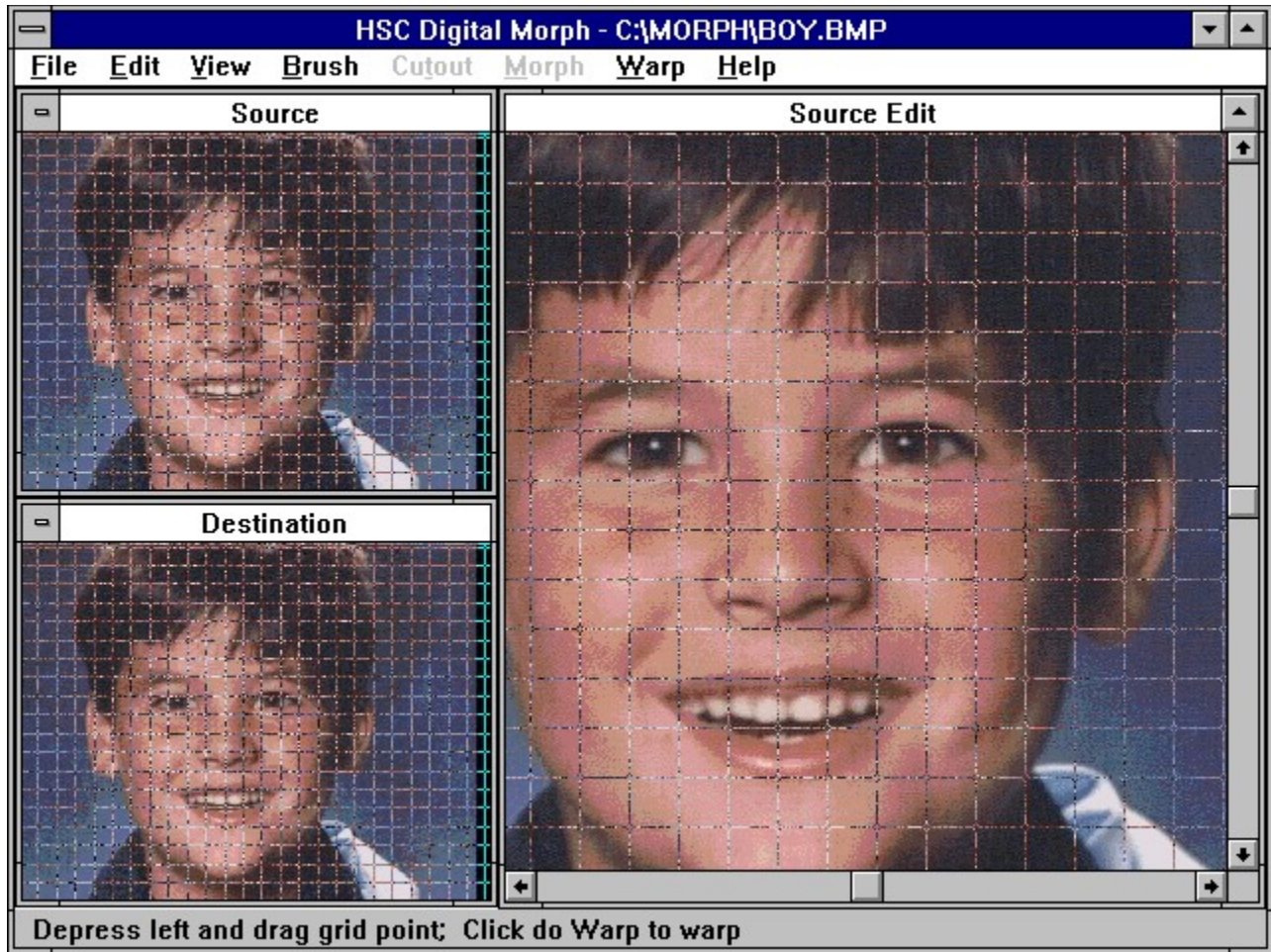


3. Click on No.

A grid will appear on top of the image that you selected.



Be sure that Warp/Local Edit Warp is enabled (has a check mark next to it).



4. Press and hold the left mouse button at any grid intersection. Drag the point to the desired location.

For example, try elongating the boy's ears like Mr. Spock, turning his smile into the Joker's grin, or giving him Pinnochio's nose. The image will warp when the button is released.



Grid lines should not cross over each other as this might cause image artifacts (undesirable results!) to occur.

## Saving Warps

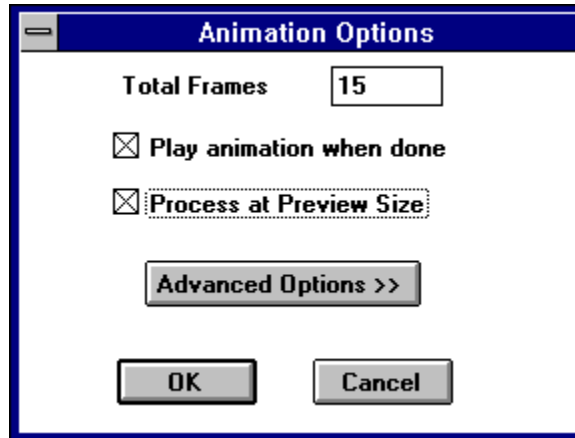
1. To save a warp grid, choose [File/Save As/Save Warp As...](#) and enter a filename for the grid.



It is not necessary to enter the file's extension. The extension .GRD is added automatically to all grid files.

## Animating a Warp

1. Click off [Warp/Local edit warp](#) (no check mark should be present).
2. Choose [File/Animate/Animate Warp](#). Have both "Play animation when done" and "Process at Preview Size" enabled (with an X).



3. Enter the total number of frames to animate in the frames box. For this example, enter 15.
4. Click OK. Each frame will be produced in turn. Note that full image warping can be a lengthy operation. Press the Esc key to terminate the process, if necessary.
5. When the processing is finished, the Media Player will appear. Click on the Play button to view the animation. Close the Media Player to return to Digital MORPH



An animation will automatically be saved as an .AVI file.








## Closing the Current File

1. Choose [File/Close](#). All images, fields, warps, and animations will be closed.

This concludes the Quick Start section of this manual.



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## IMAGE MORPHING: Overview

Morphing is a technique used to give the illusion of one image melting into another. It is accomplished by defining areas on the first image (the source) that will be reshaped to match corresponding areas on the second image (the destination).



[Click here for a quick step-by-step review on how to do a morph.](#)



Morphs can be done with one or two images. Single-image morphs are simply reshaped or distorted versions of themselves. The source and destination are the same image. The more traditional morph uses two images to give the illusion that the first image is changing into the second.

The morphing techniques described in this chapter utilize still images. Digital MORPH is unique in that it will also do full-motion morphs. A full-motion morph uses animations instead of still images so that, for example, a train speeding down the tracks could be morphed into a flying airplane. Full-motion morphs are discussed in another chapter.

A common example of still-image morphing is to morph one face into another. In this case, the shape of the first face, as well as the eyes, ears, nose, mouth, etc., would be reshaped to match the corresponding areas of the second face. This method of matching areas of one image to another is accomplished with field lines.

## Field Lines

Morphing uses a line or set of lines called field lines to affect a change. These lines need not all be connected together; in fact, it is often desirable to have disconnected sets of field lines so that multiple parts of an image can be affected.



There is a limit of 1000 field lines in a morph.

The simplest morph utilizes one field line. Imagine the line placed horizontally across the source image. This is called the source field. Now, imagine placing that same field line on the destination image (it is now the destination field) and swinging it so it is vertical. The destination image will rotate 90 degrees around the destination field line. Now, if the length of the line is shortened, the image will shrink; or if it is lengthened, the image will grow. If the field line is moved to the left or right, the image will also move to the left or right.

Typically, morphs are created using more than one field line. Suppose you wanted to morph an oval face into a square face. First, you would create an oval field by outlining the contour of the face with multiple field lines. The field lines would then be rearranged on the destination image to resemble a square. When the morph is executed, the oval face would be reshaped into a square face.

The movement of these lines is critical to how the image will be reshaped. For instance, if the square is much smaller than the face, the face will shrink as well as become square. Or, if the upper left field line is moved to the lower right portion of the image, the face will rotate.

Some practice and care is needed when entering the source field lines so there are enough fields to achieve the desired result. For example, to change a square into a circle, one might first attempt this with just four field lines. However, this will not work very well because many field lines are needed along the edges of the square to transform it into a smooth circle.



Keep the destination image in mind when entering the source field lines to assure that you have enough field lines to achieve the desired result.



## New Field Lines

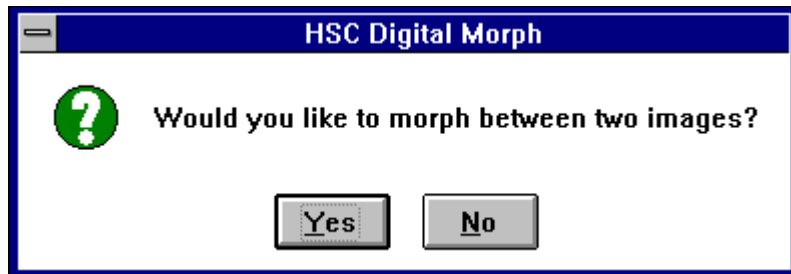
New field lines can be added at any time. To add field lines to an image, an existing morph must be opened or a new morph must be created.

## Opening an Existing Morph

1. Choose **File/Open/Open Morph**. The Open Morph dialog box is presented.
2. Select a morph (a .FLD file) and click OK. If any images are currently open when the Open Morph command is executed, the field lines contained in the morph file will be overlaid onto these open images. Any images contained within the morph file will not be opened. If you do not want this result, be sure and close all files before choosing **File/Open/Open Morph**.

## Beginning a new Morph

1. Choose **File/New/New Morph**. The Open Image File dialog box is presented.
2. Select an image and click OK. This image will be your source image (the image that will be morphed into something else).
3. At this point, a prompt appears to ask you if you would like to morph between two images. If you would like to open a second image for a two-image morph, select Yes. Otherwise, select No.



Two Image mode may be toggled on or off at any time by choosing Morph/Two Image Mode.

When the image or images have been opened, the Morph Field Lines Entry screen is presented showing the source image.



The destination image is also open although you can't see it at this time. The cursor is now in the shape of a cross.

4. Position the cursor somewhere on the image where a field is to be defined and click the left mouse button. The beginning point of a field line is defined.

If you make a mistake selecting a point, choose [Edit/Backup One Point](#) to delete the last point entered, or press the B key.

5. Move to the next point where a field line point is to be defined, and click again. The first field line is complete. Continue clicking points until you are finished with this set of field lines.

### **Once the first set of field lines is complete:**

6. Choose [Edit/Penup](#). By doing this, you will lift the pen from the work surface so that a new set of field lines may be created.



If you make a mistake selecting a point, choose [Edit/Backup](#) to delete the last point entered, or press the B Key. The keyboard shortcut for [Edit/Penup](#) is the U key.

Repeat steps 4 through 6 if you wish to outline other areas of the image; that is, continue creating new source fields.

For example, if you are working with the boy and girl images that ship with Digital MORPH, you may want to create fields around the boy's (if that is your source image) face, eyes, nose, and mouth.

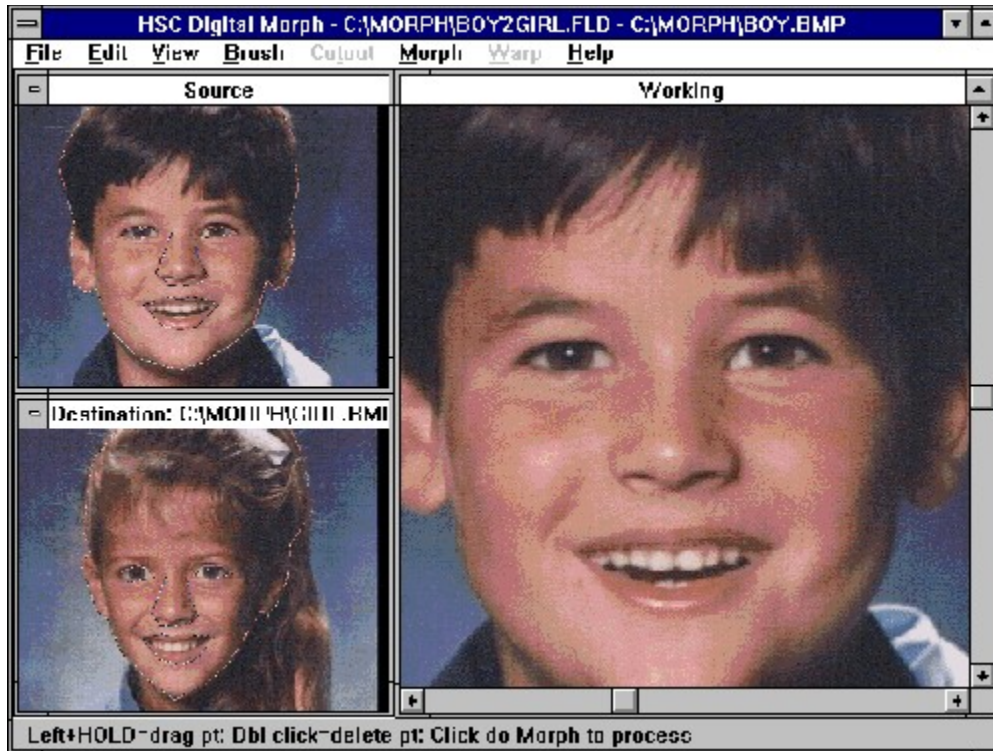


7. When all source fields are created, choose [Entry/Save](#).



To quit, choose Entry/Close, which will lose all entries in this window.

The screen will reformat into three windows, the Working window, the Source window (showing the source image), and the Destination window (showing the destination image). The Source and Destination windows will also show the field lines just created. At first, the source fields and destination fields are identical.



## Moving Field Lines

At this point, you will want to move the field lines on the destination image so that they closely match the same fields on the source image. For example, if you are doing a morph between two faces and you have created fields around the eyes on the source image, you will want to move these points so that the eyes on the destination image are also outlined.

### To modify the field lines of the destination image:

1. Double-click in the Destination window. Alternatively, choose [Morph/Edit Destination Field Lines](#). The destination image will now appear in the Working window.



You can also use the same procedure to modify the field lines of the source image at this time, if you desire.

### **To modify the field lines of the source image:**

1. Double-click in the Source window. Alternatively, choose **Morph/Edit** Source Field Lines. Moving field lines can be accomplished in two ways, moving a single point or moving multiple points.

### **To move a single point:**

1. Press and hold the left mouse button on the point to move; then drag the point to the desired position.

### **To move multiple points:**

1. Press and hold the right mouse button and draw a box around the points to be moved.
2. Move the cursor inside the box. It will change into an arrow.
3. Press the right mouse button, hold, and move the mouse. All the points inside the box will move together. Release when finished. This can be repeated as needed.

## Adding Field Lines

Additional field lines can be added to the source image at any time during the morph creation process as one or more new source fields. It is not possible to add field lines to an existing source field.

### To add additional field lines to a source image:

1. Choose [Morph/Add Field Lines](#).

The Morph Lines Entry screen will appear showing the source image and existing field lines.

At this point, follow the same procedure described above in steps 4 through 6 of Beginning a New Morph.

## Deleting Field Lines

Field lines can be deleted at any time from a source or destination image.

### To delete a field line:

1. Double-click on the image to move it to the Working window.
2. Select the field line to be deleted by double-clicking on an adjacent field line point. A prompt will appear to confirm the deletion of the field line.
3. Select Yes to confirm the deletion of the selected field line.



The field line point connected to the deleted point and line will automatically be reconnected to the closest field point.

## Copying Field Lines

Field lines once entered, can be copied from the source

image to the destination image, from the destination image to the source image, or swapped from image to image.

This is very useful if mistakes are made while moving field lines, linking morphs (see Chapter 6), etc..

## **Copy Source Fields to Destination**

Copying source fields to the destination image will delete any changes to the field lines on the destination image. The result will be that both the source image and destination image will have identical field lines.

### **To copy source field lines to the destination image:**

1. Choose [Morph/Copy Source Fields to Destination](#).

## **Copy Destination Fields to Source**

### **To copy destination field lines to the source image:**

1. Choose [Morph/Copy Destination Fields to Source](#).

## **Swap Source and Destination Fields**

To replace the source field lines with the field lines of the destination image and vice versa:

1. Choose [Morph/Swap Source and Destination Fields](#).

## Field Line Parameters

The parameters which fine tune the morph are set with Morph/Parameters. These parameters can have dramatic effects on the way morphing occurs. The default values are designed to work with a wide variety of images and most applications. If you should decide to vary these parameters, it is advised to do so one at a time to see the effect.

### Strength

The process of morphing involves pulling pixels from one relative location to another. It is the placement of the field lines that establishes which pixels will be pulled. The strength parameter determines how strongly the lines will influence the surrounding pixels. The higher the strength value, the greater the number of pixels in the source image that the field line will pull to the destination image. Line strength values can be from 0 to 1000, with 1000 being the strongest.



A line strength value of 25 will be appropriate for most morphs.

### Falloff

The falloff parameter determines how the relative strength of different lines change with distance from any one pixel. If the falloff value is zero, then each pixel will be affected by all lines equally. As the value increases, each pixel will be affected more by the line nearest to it.

In general, it is advised to first modify the falloff parameter, then the strength parameter. Also, if you have frozen the image edges (by selecting Freeze Image Edges), and find "holes" in the image, this is because the falloff value is set too high.

Because the falloff is related to pixels, a value that works fine in preview mode may not work correctly when morphing with preview mode turned off.

### Line Weight

The value of line weight is usually between 0 and 1. If the value of the line weight is set at zero, then all the field lines have the same weight. If the line weight value is greater than zero, then longer lines will have a greater relative strength than the shorter lines.





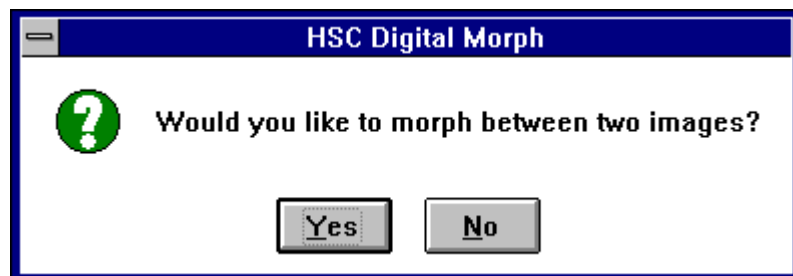
## Two Image Mode

Morphs can be done with one or two images. Single-image morphs are simply reshaped or distorted versions of themselves. The source and destination are the same image. The more traditional morph uses two images to give the illusion that the first image is changing into the second.

Selecting Two Image mode can be done at the beginning of the morphing process and it can be toggled on or off during the morphing process.

### To choose Two Image mode:

1. Choose [File/New/New Morph](#). The Open Image File dialog box is presented to choose an image to morph.
2. Select an image and click OK. This image will be your source image (the image that will be morphed into something else). At this point, a prompt is given to ask if you would like to morph between two images.



3. Select Yes.

The Open Image File dialog box is presented once again.

4. Select an image and click OK. This is your destination image (the image that your source image will be morphed into).

Or, if you are already in One Image mode:

1. Choose [Morph/Two Image Mode](#).

The Open Image File dialog box is presented.

2. Select an image and click OK.

## Preview Mode

Because creating morphs at full screen can take a few moments to process, a preview mode is available. The preview mode will process a smaller copy of the image, thus saving time. After processing the morph, the result will be displayed in the Working window as a smaller image.

The preview can be set to be a specified percentage of the original image size.

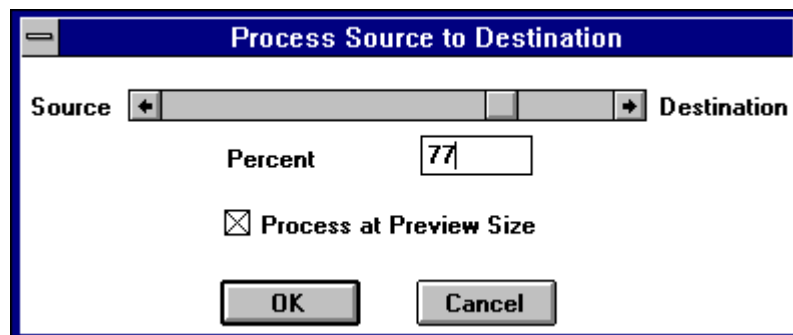
### To define the preview size:

1. Choose [File/Preferences/Preview Shrink Factor](#). A prompt will appear asking for a value of one through 32. A value of 1 will give a preview size that is equal to the original image. A value of 2 will give a preview that is one-half the size of the original image, a value of 3 will give a preview that is one-third the size of the original image and so on.

The default setting is 4, giving a preview that is one-quarter the size of the original image.

### To morph an image at preview size:

2. Follow the procedures for creating a new morph.
3. Choose [Morph/Do Morph](#). You will be presented with the Process Source to Destination dialog box.



4. Toggle Process at Preview Size on and click OK. The morph will be processed at the size you designated with [File/Preferences/Preview Shrink Factor](#).

Preview mode is also very useful when generating animation. The smaller images and files generally play back faster than larger ones. This is useful for testing the morph before committing to creating the animation at full screen.

## Morphing

Once field lines have been entered on the source and destination images, the actual morphing process can take place. Morphs can be processed resulting in a single frame or a series of frames which can then be animated.

A single-frame morph is essentially a composite of the source and destination images. For example, a single-frame morph between two people processed at 50 percent would result in a single image that is 50 percent of the first person and 50 percent of the second person.

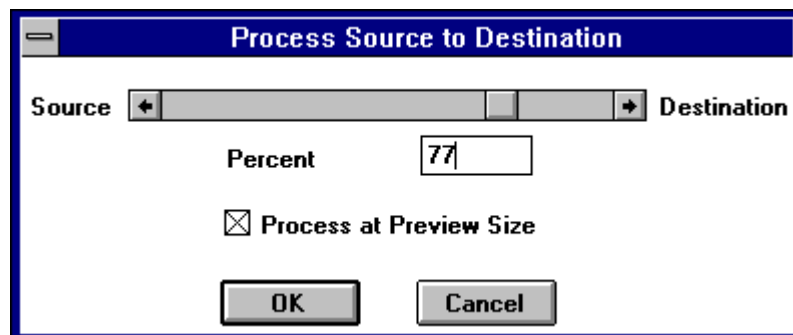


An animated morph of the two people would produce a gradual transition between the two images over a period of time.

## Single Frame Morph

A single-frame morph will produce one image.

1. Enter field lines on a source and destination image as described earlier in this chapter.
2. Choose **Morph/Do Morph**. The Process Source to Destination dialog box appears.



You can determine the degree to which the source image will be morphed into the destination image. For example, if you choose 50%, the result you see will be a morph that's about half the source image and half the destination image. You can choose to process the morph at 100% or anywhere in between the source and destination images.

3. Enter the desired Percent value and toggle the Process at Preview Size off if you wish to view the morph full screen. Click OK to view the completed morph.

## Animating the Morph

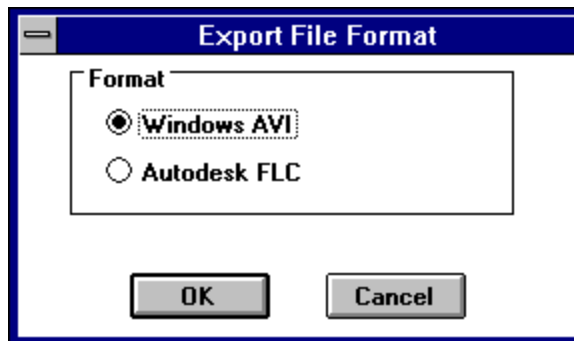
Animated morphs can be saved as a Video for Windows™ .FLC file, or a series of individual image files. This section describes the procedure for creating an animation file from a still-image morph. Full-motion morphs are described in Chapter 6.



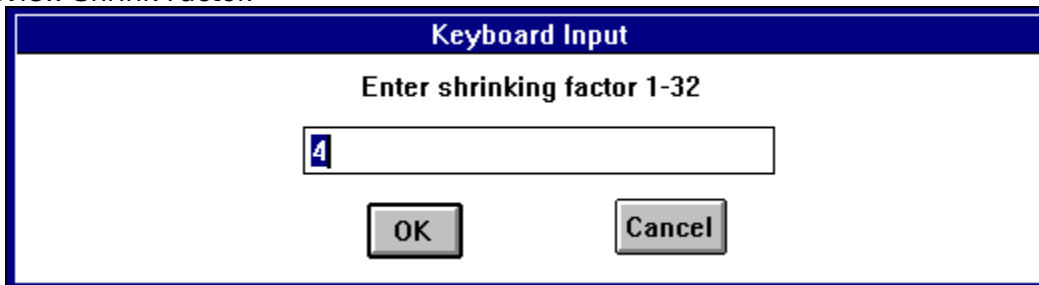
To use the Digital MORPH default settings, start with step # 5.

### To animate the morph.

1. Choose [File/Preferences/Export Format](#). The Export File Format dialog box will appear.

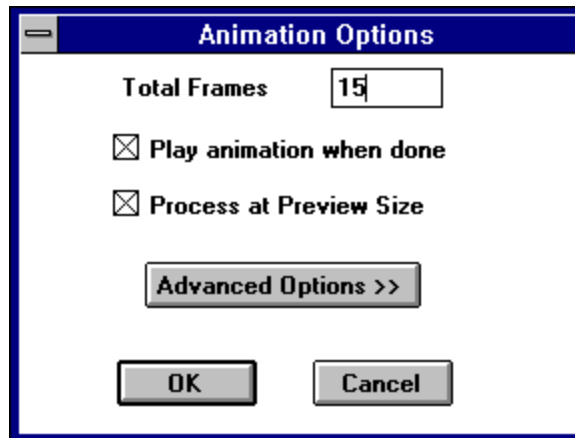


2. Select either Windows AVI or Autodesk FLC and click OK.
3. Choose [File/Preferences/Preview Shrink Factor](#). A dialog box will appear asking for the Preview Shrink Factor.



4. Enter a value and click OK.
5. Choose [File/Open/Open Morph](#). Select a morph (.FLD) to animate.
6. Choose [File/Animate/Animate Morph](#). You will

now be presented with the Animation Options dialog box.



7. Enter the desired number of frames.



[Click here for detailed information about the animation options and advanced animation options.](#)

The number of frames will determine the length of time the animation will play. The more frames, the longer the animation will play.

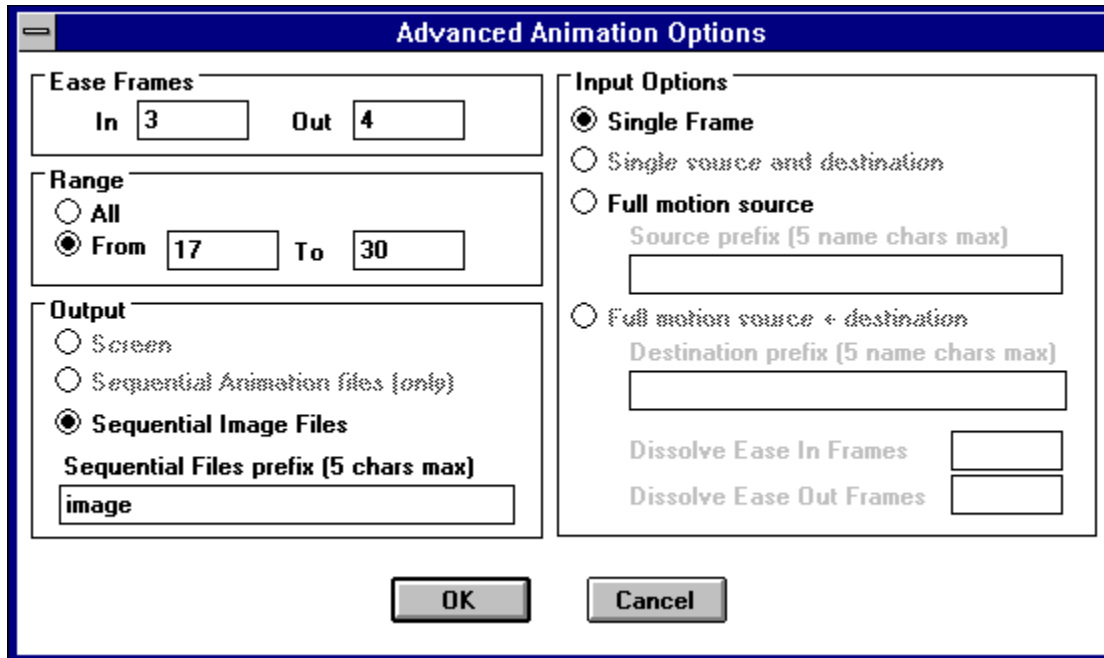
8. Toggle Play Animation When Done on.

9. Toggle Process at Preview Size on if you would like to have the animation created at a reduced size. This is recommended since the animation will play faster and smoother at a size smaller than full screen.

Toggle Process at Preview Size off if you would like the animation to be the same size as the original input images. The animation will be named the same as the source image. If you would like to change this name, continue with the next step, otherwise continue with step 12.

10. Select Advanced Options.

You will be presented with the Advanced Animation Options dialog box.



Under Output options, you will see the name of the source image entered as the Sequential Files Prefix.

11. Replace the file name with the desired file name and click OK. You are now returned to the Animation Options dialog box.

12. Click OK. The animation will now be processed. This will take a few moments depending on the number of frames you have requested.

When the animation process is concluded, the appropriate animation player will be launched depending on which option you chose in Step 2 above.

13. View the animation by clicking on the Play button.

## Saving Files

Once a single-frame morph is processed, you have the option of saving the morph as an image file or as a morph file.

### Saving a New Image

A single-frame morph may be saved in a variety of file formats.

#### To save a new image:

1. Choose [File/Save As/Save Image As](#). You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the image in the filename text box.
3. Select the desired file type.
4. Click OK.

### Saving Morphs

Morphs are saved as Field files (.FLD). Field files contain information about morph field lines. The file contains both the source and destination field lines, along with any animation frame information.

#### To save a new morph:

1. Choose [File/Save As/Save Morph As](#). You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the morph in the filename text box.
3. Click OK.

#### To save changes to an existing morph:

1. Choose [File/Save/Save Morph](#). Any changes to the morph will now be saved.



## Closing the current file

1. Choose [File/Close](#). All images and field files are closed. If any changes were made, you will be prompted to save the appropriate item. A No response will not save, while a Cancel response will cancel the request completely, leaving the item intact.

To go to any of the following topics, click on its title:



[Overview](#)



[Field Lines](#)



[New Field Lines](#)



[Moving Field Lines](#)



[Adding Field Lines](#)



[Deleting Field Lines](#)



[Copying Field Lines](#)



[Field Line Parameters](#)



[Strength](#)



[Falloff](#)



[Line Weight](#)



[Two Image Mode](#)



[Preview Mode](#)



[Morphing](#)



[Single Frame Morph](#)



[Animating the Morph](#)



[Saving Files](#)



[Saving a New Image](#)



Tips

Saving Morphs



Tips

Closing the Current File

## IMAGE WARPING: Overview

Image warping is a technique used to reshape portions of an image. The effect can also be called a morph, but we classify warps and morphs differently because the techniques (and the underlying mathematical calculations) used to achieve each are different.

Warping is accomplished by moving points on a grid system. The grid can be any size you choose. Each intersection point, where a horizontal and vertical grid line meet, can be moved. This movement in turn distorts the image.



## Warp Grid

### Grid Size

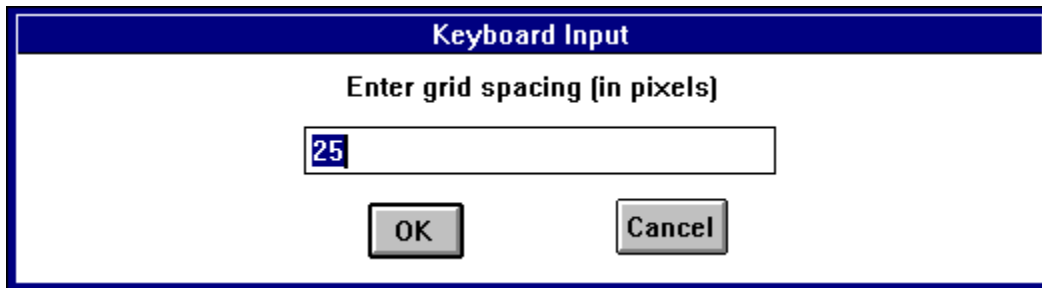
The size of the grid may be adjusted to a small, medium, or large size. The size of the grid can be changed if greater or lesser detail is desired. As the grid size decreases, the degree of detail in the warp increases.

#### To change the size of the grid:

1. Choose [Warp/Grid Size](#) and select either a small, medium or large grid. You may find the small, medium or large grid sizing to be insufficient to generate the proper amount of grid lines.

#### To enter your own value for the grid sizing:

1. Choose [Warp/Grid Size/Set](#) and enter a new value.



The image shows a dialog box titled "Keyboard Input" with a white background and a dark blue border. Inside the dialog, the text "Enter grid spacing (in pixels)" is centered above a text input field. The input field contains the number "25". Below the input field are two buttons: "OK" and "Cancel".

The number represents the size of the grid square in pixels.

### Grid Corner

Warping is achieved by dragging intersecting points on the grid. You may find that a point does not exist in the exact location where you would like to affect a change. Use the Grid Corner function to place a grid intersection point.

Grid intersection points can also be moved by using the Set Horizontal and Set Vertical functions described in the next section.

#### To set a grid corner:

1. Choose [Warp/Set Corner](#).

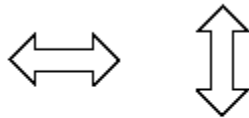
2. Position the cursor where you would like to place a grid intersection point and click the left mouse button. The closest grid intersection point will be repositioned to that coordinate.

## Horizontal and Vertical Grid Lines

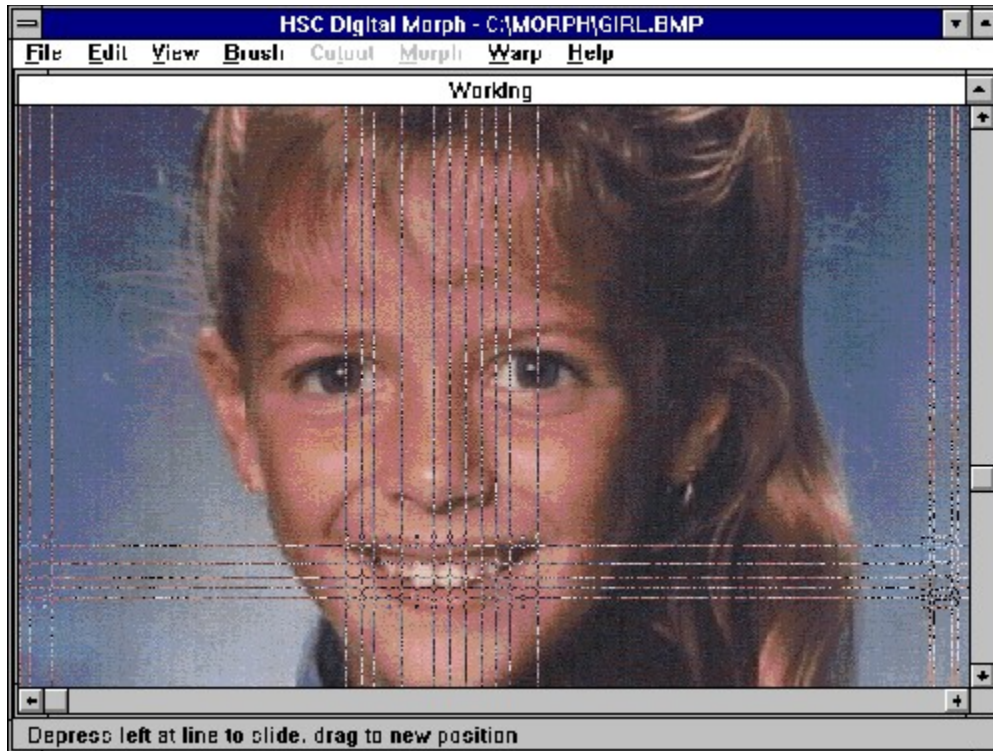
Usually the grids you will use to warp images will be square. However, this does not have to be the case. Use the Set Horizontal and Set Vertical functions to customize the grid. This is done before warping begins to set up points which will allow for more precise control over the warp effect.

### To adjust horizontal or vertical grid spacing:

1. Choose [Warp/Set Horizontal](#) or [Warp/Set Vertical](#). The cursor will change to a double-headed arrow.



2. Position the cursor over the desired horizontal or vertical line to be moved. Press and hold the left mouse button, while dragging the line to the new position. Continue this process until all lines are in their desired position.



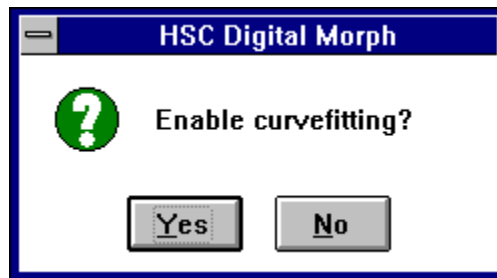
Here the grid lines have been set to more strategic locations. In this example, they are set to more easily affect the area around the mouth.

## Curve Fitting

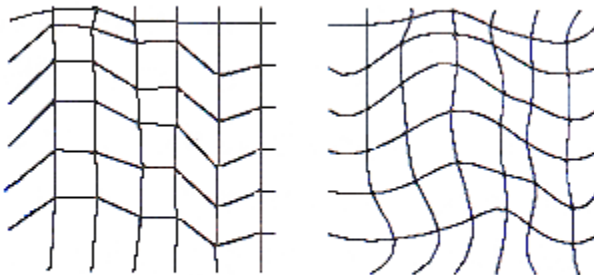
When the grid points are dragged, the grid lines themselves can either remain straight, or become curved. This is controlled by either disabling or enabling curve fitting, respectively. Curve fitting will take a little longer to process, but should produce better looking images because that portion of the image will curve, too.

### To enable curve fitting:

1. Choose [File/Preferences/Curve Fitting](#).



2. Select Yes if you would like curve fitting enabled, otherwise select No.



This example shows a warp grid with curve fitting disabled on the left and enabled on the right.



## Copying Warp Grids

When doing a full-image warp or when warping two images, you will be working with a source and destination image. Warp Grids once entered, can be copied from the source image to the destination image, from the destination image to the source image, or swapped from image to image.

This is very useful if mistakes are made while moving grid lines, linking Warps , etc..

See Also: [Creating Full Motion Animated Morphs and Warps.](#)

### **Copy Source Grids to Destination**

Copying source grids to the destination image will delete any changes to the grids on the destination image. The result will be that both the source image and destination image will have identical grids.

#### **To copy the source grid to the destination image:**

1. Choose [Warp/Copy Source Grid to Destination](#).

### **Copy Destination Grids to Source**

#### **To copy the destination grid to the source image:**

1. Choose [Warp/Copy Destination Grid to Source](#).

### **Swap Source and Destination Grids**

#### **To replace the source grid with the grid of the destination image and vice versa:**

1. Choose [Warp/Swap Source and Destination Grids](#).

## Warping

### Local Vs. Full Image Warping

There are two basic types of warping: local and full image.

Local warping is the faster but less precise method. When you drag a grid point, you will see the result immediately upon releasing the mouse. Local warping only affects the sections of the grid immediately adjacent to the grid intersection point moved.



Local warping can be used as a guideline to help set up a full-image warp.

On the other hand, when doing a full-image warp, you will not see the effects of moving grid points until you choose Do Warp from the Warp menu. Full-image warping also differs from local warping in that the warp effect will extend beyond the adjacent grids surrounding the points being moved. Because of this, full-image warping is much smoother than local warping and produces generally more pleasing stretches. However, full-image warps will take longer to process.

The screen format will also change based on the warping method. If local warp is enabled, the edit window will occupy the full screen. If full-image warp is enabled, the screen will display the three-window interface consisting of the Source window, the Destination window, and the Working window.

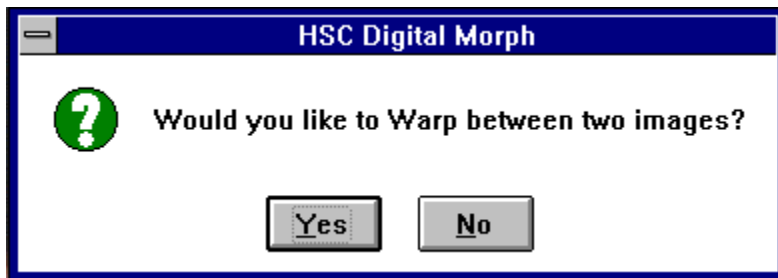
### Opening an Existing Warp

1. Choose [File/Open/Open Warp](#). The Open Warp dialog box is presented.
2. Select a warp (a .GRD file) and click OK. If any images are currently open when the Open Warp command is executed, the grids contained in the warp file will be overlaid onto these open images. Any images contained within the warp file will not be opened. If you do not want this result, be sure and close all files before choosing [File/Open/Open Warp](#).

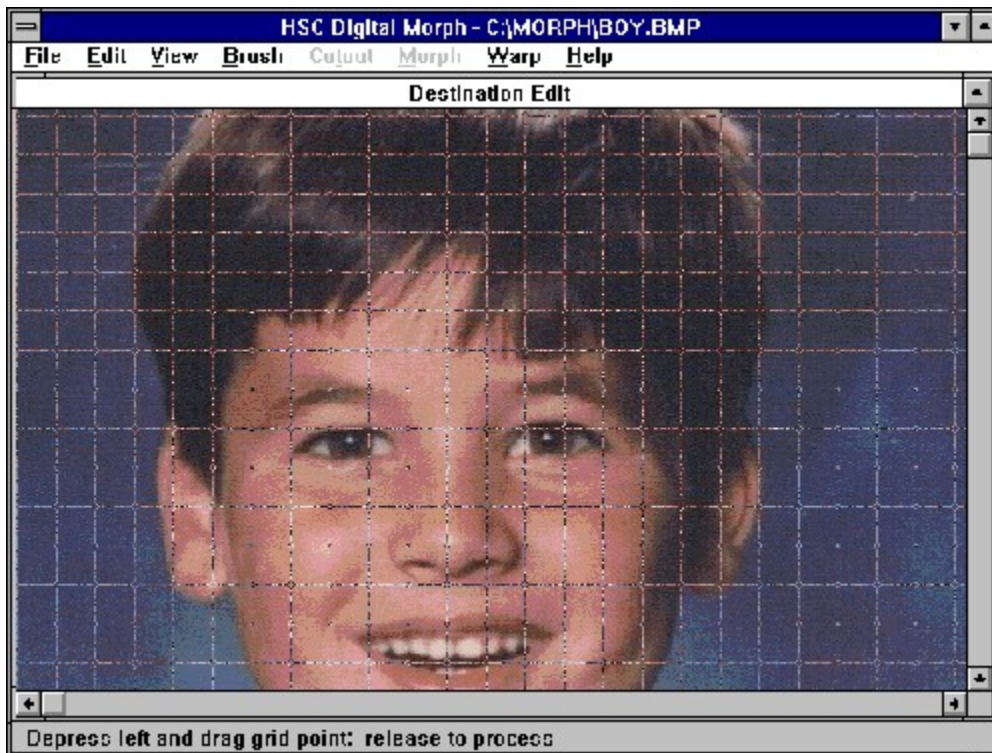
### Creating a Local Warp

1. Choose [File/New/New Warp](#). The File Selection dialog box is presented to choose an image to warp.
2. Select an image to warp and click OK.

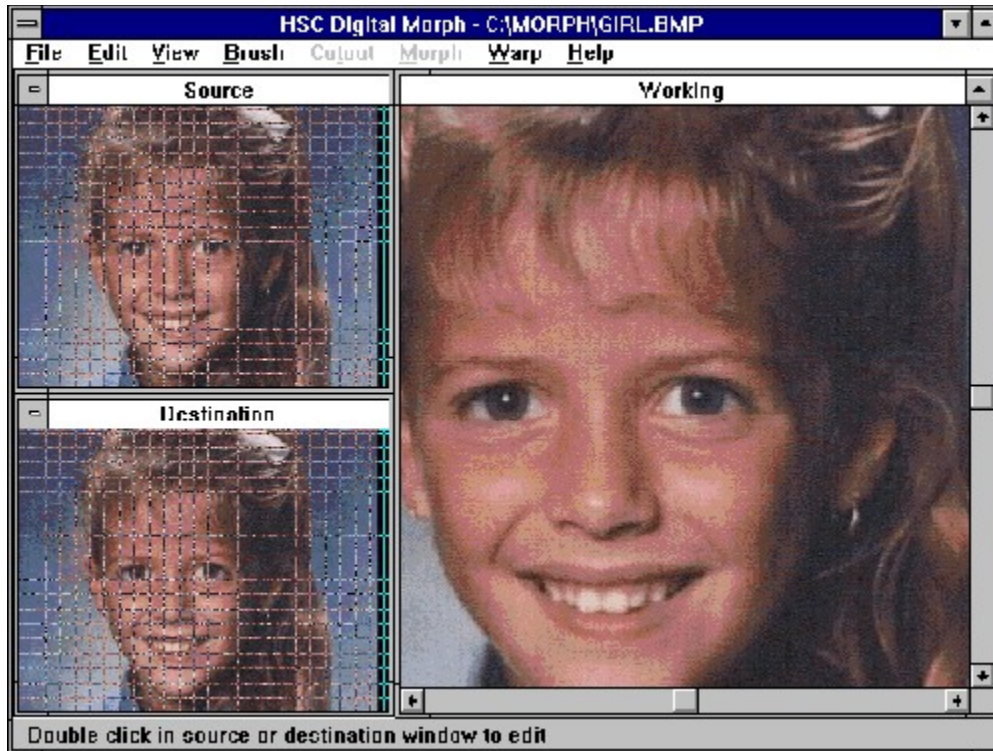
3. Respond No to the prompt: Would you like to warp between two images? Two Image mode does not apply when doing a local warp.



If [Warp/Local Edit Warp](#) is enabled, the image you selected will appear in the edit window overlaid with a grid.



4. If the three-window interface appears, then choose Warp/Local Edit Warp to enable local warp.



In order to more precisely control the warp effect, you can, at this point, change the size of the grid, set a new grid point intersection, move the horizontal or vertical grid lines, or enable curve fitting.

5. If you like, choose [Warp/Grid Size](#), [Warp/Set Corner](#), [Warp/Set Horizontal](#) and/or [Warp/Set Vertical](#) to readjust the grid. Choose [File/Preferences/Curve Fitting](#) to enable curve fitting. These functions are described earlier in this chapter.

6. Press and hold the left mouse button at any grid intersection point. Drag the point to the desired location.

The image will warp when the button is released.



Do not allow grid lines to cross over each other or image artifacts may occur.

## Creating a Full Image Warp

1. Choose [File/New/New Warp](#).

The File Selection dialog box is presented to choose an image to warp.

2. Select an image to warp and click OK.

3. Respond No to the prompt: Would you like to warp between two images? Two Image mode is

described in the next section.

If the three-window interface appears, you are ready to do a full-image warp. If the image you selected appears in the single edit window, then you are in local warp mode.

4. If necessary, enable full-image warp by toggling [Warp/Local Edit Warp](#) off. The image you selected will appear in each of the three windows. You will use the Working window to move grid points.

In order to more precisely control the warp effect, you can, at this point, change the size of the grid, set a new grid point intersection, move the horizontal or vertical grid lines, or enable curve fitting.

5. Double-click in the Destination window to move the destination image into the Working window.

6. Choose [Warp/Grid Size](#), [Warp/Set Corner](#), [Warp/Set Horizontal](#) and/or [Warp/Set Vertical](#) to readjust the grid. Choose [File/Preferences/Curve Fitting](#) to enable curve fitting. These functions are described earlier in this chapter.

7. Press and hold the left mouse button at any grid intersection point on the image in the Destination window. Drag the point to the desired location.

8. Continue dragging points as you like to achieve the desired result.

9. Choose [Warp/Do Warp](#) to see the warp.



Do not allow grid lines to cross over each other or image artifacts may occur.

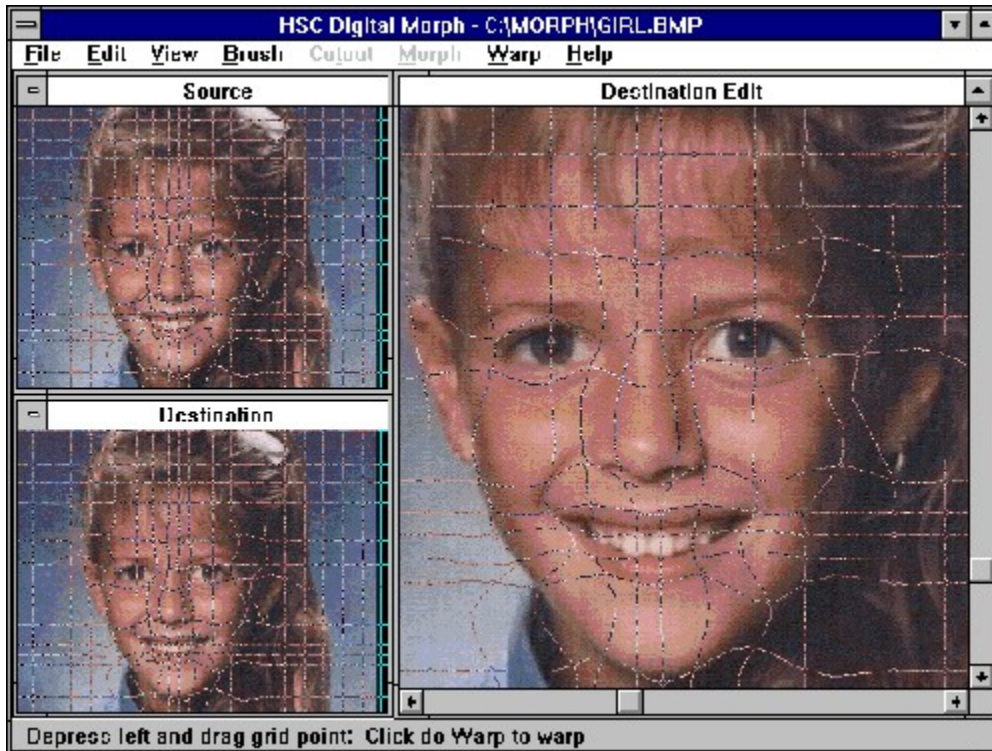
## Creating Irregular Grids

When adjusting the grid with the Set Corner, Set Horizontal, or Set Vertical functions, the result is limited to "squarish" stretching. Even with curve fitting, the image may not stretch as desired. In addition, adjusting the grid with these functions creates identical source and destination grids.

In full-image warp mode, irregularly-shaped grids can be set up.

**To create an irregular grid:**

1. Double-click on the Source window to bring the source image to the Working window.
2. Drag points on the source image to change the shape of the grid.



This is an example of a warp grid that has been distorted to better fit the girls face.

3. Choose [Warp/Copy Source Grid to Destination](#) to overlay the source grid on the destination image.
4. Double-click on the Destination window to bring the destination image to the Working window.
5. Drag points on the destination image to change the shape of the grid.
6. Choose [Warp/Do Warp](#) to see the warp.

## Two-Image Mode

Full-image warping can be used to match areas of two different images.

1. Choose [File/New/New Warp](#).

The File Selection dialog box is presented to choose an image to warp.

2. Select an image to warp and click OK.
3. Respond Yes to the prompt: Would you like to warp between two images?

The first image you selected will appear in the Source window and the Working window. The second image will appear in the Destination window. You will use the Working window to move grid points.

Generally, non-square grids are used to match like areas of the images. Follow the same procedure as described above in the section Creating Irregular Grids.

## Preview Mode

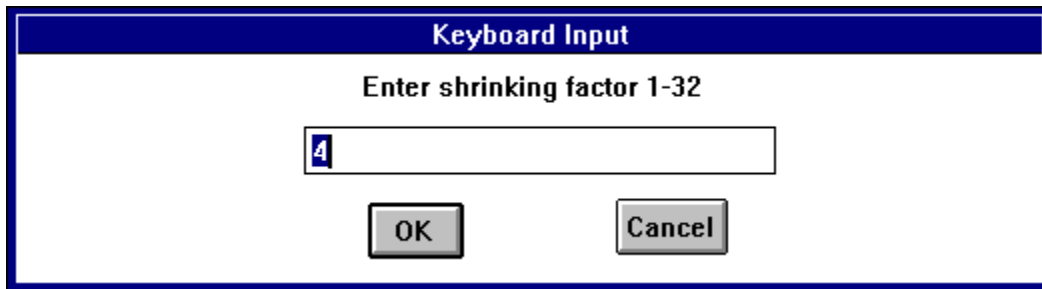
Because warping images can take a few moments to process, a preview mode is available for full-image warps. The preview mode will process a smaller copy of the image, thus saving time. After processing the warp, the result will be displayed in the Working window as a smaller image.

The preview can be set to be a specified percentage of the original image size.

### To define the preview size:

1. Choose [File/Preferences/Preview Shrink Factor](#).

A prompt will appear asking for an input of 1 through 32.



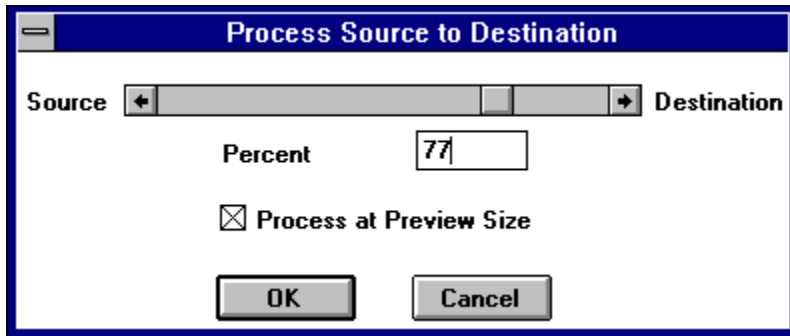
A value of one will give a preview size that is equal to the original image. A value of 2 will give a preview that is 1/2 the size of the original image, a value of 3 will give a preview that is 1/3 the size of the original image and so on.

The default setting is 4, giving a preview that is one-quarter the size of the original image.

### To warp an image at preview size:

1. Open one or two images for a full-image warp (toggle Local Edit Warp off).
2. Adjust the grid lines to create the warp.
3. Choose [Warp/Do Warp](#). You will be presented with the Process Source to Destination dialog box.





4. Toggle Process at Preview Size on and click OK. The warp will be processed at the size you designated with [File/Preferences/Preview Shrink Factor](#).

Preview mode is also very useful when generating animation. The smaller images and files generally play back faster and smoother than larger ones. This is useful for testing the warp before committing to the full-sized image warp animation.

## Animating the Warp

Animated warps can be saved as a Video for Windows



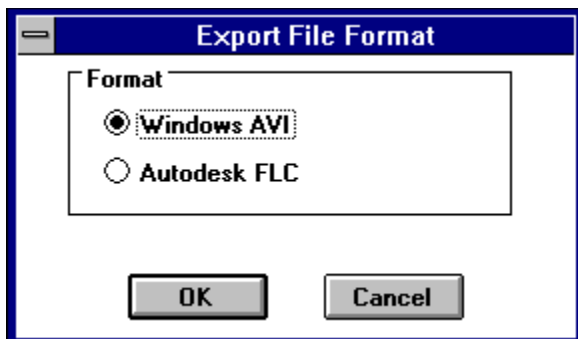
.FLC file, or a series of individual image files. This section describes the procedure for creating an animation file from a full-image warp.

See Also: [Full-motion warps](#)



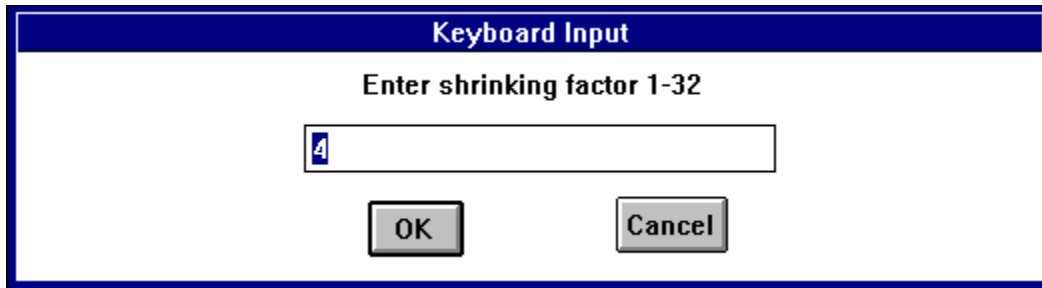
To use the Digital MORPH default settings, start with step # 5.

1. Choose [File/Preferences/Export Format](#). The Export File Format dialog box will appear.

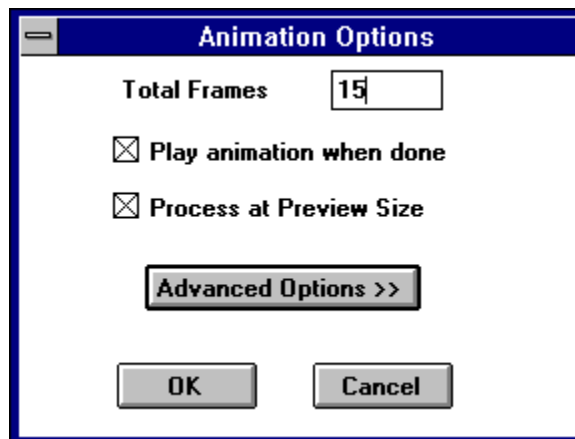


2. Select either Windows AVI or Autodesk FLC and click OK.

3. Choose [File/Preferences/Preview Shrink Factor](#). A dialog box will appear asking for the Preview Shrink Factor.



4. Enter a value and click OK.
5. Choose [File/Open/Open Warp](#). Select a warp (.GRD) to animate.
6. Choose [File/Animate/Animate Warp](#). You will now be presented with the Animation Options dialog box.



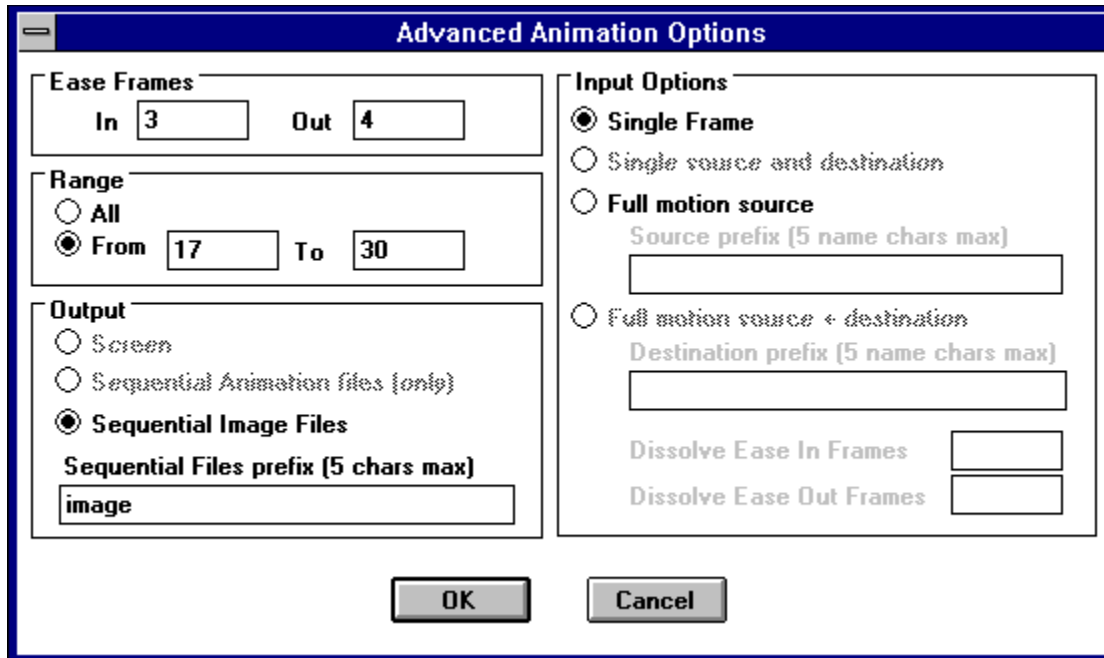
7. Enter the desired number of frames. The number of frames will determine the length of time the animation will play. The more frames, the longer the animation will play.
8. Toggle Play Animation When Done on.
9. Toggle Process at Preview Size on if you would like to have the animation created at a reduced size. This is recommended since the animation will play faster and smoother at a smaller size.

Toggle Process at Preview Size off if you would like the animation to be the same size as the original input image(s).

The animation will be named the same as the source image. If you would like to change this name, continue with the next step, otherwise continue with step 12.

10. Select Advanced Options.

You will be presented with the Advanced Animation Options dialog box.



Under Output options, you will see the name of the source image entered as the Sequential Files Prefix.



[Click here to see detailed information about the animation options and advanced animation options.](#)

11. Replace the file name with the desired file name and click OK.

You are now returned to the Animation Options dialog box.

12. Click OK.

The animation will now be processed. This will take a few moments depending on the number of frames you have requested.

When the animation process is concluded, the appropriate animation player will be launched depending on which option you chose in Step 2 above.

13. View the animation by clicking on the Play button.

## Saving Files

Once a warp is processed, you have the option of saving the warp as an image file or as a warp file.

### Saving a New Image

A warp may be saved in a variety of file formats.

#### To save a new image:

1. Choose [File/Save As/Save Image As](#). You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the image in the filename text box.
3. Select the desired file type.
4. Click OK.

### Saving Warps

Warps are saved as Grid files (.GRD). Grid files contain information about warp grids. The file contains both the source and destination grids, along with any animation frame information.

#### To save a new warp:

1. Choose [File/Save As/Save Warp As](#). You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the warp in the filename text box.
3. Click OK.

#### To save changes to an existing warp:

1. Choose [File/Save/Save Warp](#). Any changes to the warp will now be saved.

## Closing the current file

1. Choose [File/Close](#). All images and grid files are closed. If any changes were made, you will be prompted to save the appropriate item. A No response will not save, while a Cancel response will cancel the request completely, leaving the item intact.
2. To save the current grid, Choose [File/Save As/Save Warp As...](#) and enter a filename for the grid.

To go to any of the following topics, click on its title:



[Overview](#)



[Warp Grid](#)



[Grid Size](#)



[Grid Corner](#)



[Horizontal and Vertical Grids](#)



[Curve Fitting](#)



[Copying Warp Grids](#)



[Warping](#)



[Local Vs Full Image Warping](#)



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[Creating a Local Warp](#)



[Creating a Full Image Warp](#)



[Creating Irregular Grids](#)



[Two Image Mode](#)



[Preview Mode](#)



[Animating the Warp](#)



[Saving a New Image](#)



[Saving Warps](#)



Closing the Current File

## **CUTOUTS: Overview**

Cutouts are selected areas of an image that can be moved, scaled, rotated, flipped, and animated. Cutouts can be saved as a file or copied to and from the Windows clipboard. Only one cutout at a time can be defined and operated upon.



## Curve Fitting


Cutouts respect the current curve fitting setting. That is, if curve fitting is disabled, then the cutout shape will retain the same shape as was entered. If curve fitting has been enabled ([File /Preferences/Curve Fitting](#)), the cutout area will curve through the points entered. In addition, this curve will be smoothly blended around the last and first points entered to form a smooth, closed shape.

The use of curve fitting is somewhat of an art and requires a little practice. For the best result, it is recommended to only enter points where changes in the curve are desired. Also, enter as few points as possible to define the curve.

## Creating and Editing Cutouts

### Creating Cutouts

To create a cutout:

1. Choose [File/New/New Cutout](#). If an image file is not open, the File Selection dialog box will be presented.
2. Select an image from the list and click OK. The image will appear in the Cutout Entry window and the cursor will change to a '+'.  

3. Click the left mouse button at points around the area to be cut out to define the cutout boundary.

Cutouts require a minimum of three points. Do not allow edges of the cutout boundary to cross over one another. Rather bizarre effects are seen if this occurs.

If you make a mistake selecting a point, choose [Edit/Backup One Point](#) to delete the last point entered, or press the B key.

It is not required to enter the last point right at the first point (nor should this be done) as the outlined boundary will be closed automatically.

4. Choose [Entry/Save](#) to save the cutout boundaries. This procedure does not save the cutout as a file.

The screen will change to the Working window and the Cutout/Copy Mode will automatically be enabled.



Choose [Entry/Close](#) to exit without saving a cutout.

### Editing Cutouts

Cutouts are manipulated using the tools in the Cutout menu.

## Cut

1. Choose [Cutout/Cut](#). The cutout is now cut but you can't see the effect until you move it.
2. Press the left button and drag the mouse to move the cutout. The area under the cutout's original position will be set to the transparent color.
3. Press the right button to paste the cutout at its new position.

## Copy Mode

1. Choose [Cutout/Copy Mode](#).

The cutout is now copied.

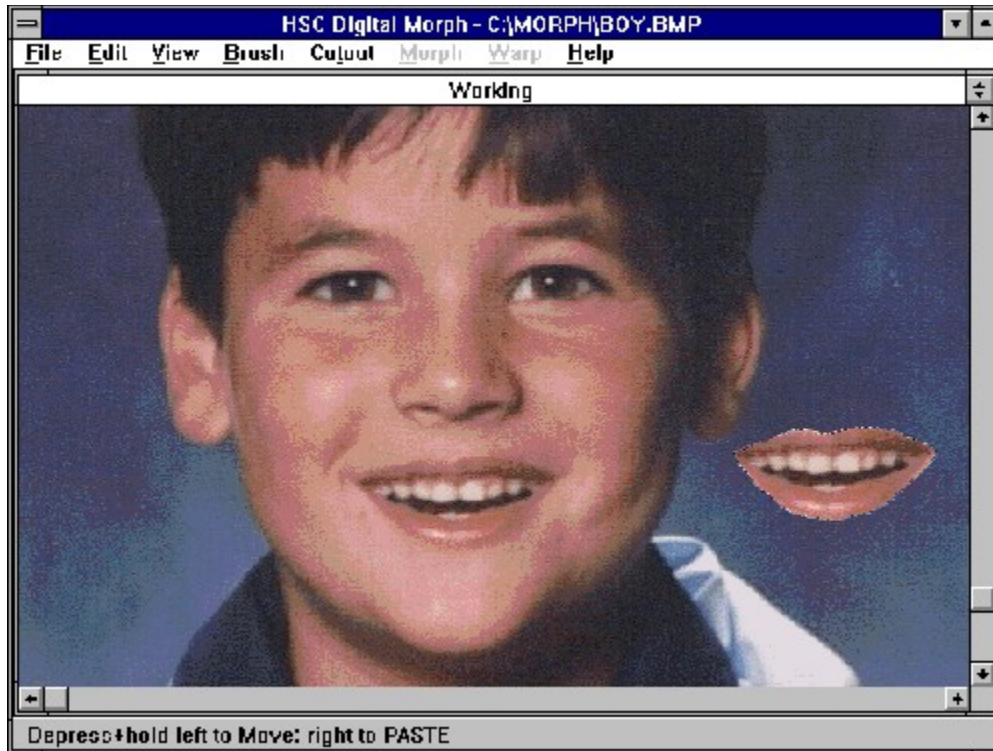


The active Cutout function is indicated by a check mark next to it on the Cutout menu.

2. Press the left button and drag the mouse to move the copy of the cutout.
3. Press the right button to paste the copy at its current position.



The right mouse button is used to paste for the copy, rotate, scale, size and deform operations.



## Deforming

1. Choose [Cutout/Deform](#). The cutout area will be outlined and the original outline points will appear. These are now moveable points.
2. Press, hold, and drag the left mouse button at one or more of the outline points to deform the shape. When the mouse button is released, the shape will deform to the new outline.
3. Paste the cutout at its current position by pressing the right button.



## Mirror Horizontal or Vertical

The Cutout/Mirror function allows the cutout to be flipped either horizontally or vertically.

1. Choose either [Cutout/Mirror Horizontal](#) or [Cutout/Mirror Vertical](#).
2. The cutout is immediately mirrored along the selected axis. The mode is not changed.

## Rotate Mode

1. Choose [Cutout/Rotate Mode](#).

The cutout area will appear with an outline around it.

2. Press, hold, and drag the left mouse button to the left and right to spin the cutout about its own center. The outline will spin, but not the image.
3. Release the left button. The rotated image and the new outline will be displayed.
4. Press the right button to paste the copy at its current position.

## Scale Mode and Size Mode

1. Choose [Cutout/Scale Mode](#) or [Cutout/Size Mode](#). The cutout area will appear with an outline around it.

2. Press, hold and drag the left mouse button horizontally and/or vertically to change the size or scale of the cutout.

If you are scaling, right and left movements affect the horizontal scaling, while up and down movements affect the vertical scaling. If you are sizing, left and right movements affect both horizontal and vertical scaling equally.

3. Press the right button to paste the new cutout.

## Re-Copy Mode

This special mode allows you to fill an existing cutout's shape with a new portion of the image. For example, if the create a cutout and copy it to a new location, then

choose Re-copy Mode from the Cutout menu, the cutout will now be filled with the image area that is under the cutout's new position. This then becomes a new cutout and operations such as scale and deform can be performed.

1. Define a cutout.
2. Choose [Cutout/Re-Copy Mode](#).
3. Copy, rotate, scale, size, deform, etc. the shape (the image is not visible) until it is as desired.
4. Click the right mouse button. The cutout's shape will change and will take the portion of the image that is under it as the cutout image. It is as though a new entry were done with that shape.

### **Restore Original**

1. Choose [Cutout/Restore Original](#). The cutout is returned to the original orientation and position.

### **Quitting a Cutout Mode**

1. Reselect the cutout operation to remove the check mark, or select any other mode or brush.

## Animating the Cutout

Animated cutouts can be saved as a Video for Windows



.FLC file, or a series of individual image files. This section describes the procedure for creating an animation file from a cutout.



To use the Digital MORPH default settings, start with step # 5.

1. Choose [File/Preferences/Export Format](#). The Export File Format dialog box will appear.
2. Select either Windows AVI or Autodesk FLC and click OK.
3. Choose [File/Preferences/Preview Shrink Factor](#). A dialog box will appear asking for the Preview Shrink Factor.
4. Enter a value and click OK.
5. Choose [File/Open/Open Cutout](#). Select a cutout (.CUT) to animate.
6. Choose [File/Animate/Animate Cutout](#). You will now be presented with the Animation Options dialog box.
7. Enter the desired number of frames.



[Click here for detailed information about the animation options and advanced animation options.](#)

The number of frames will determine the length of time the animation will play. The more frames, the longer the animation will play.

8. Toggle Play Animation When Done on.
9. Toggle Process at Preview Size on if you would like to have the animation created at a reduced size. This is recommended since the animation will play faster and smoother at a smaller size.

Toggle Process at Preview Size off if you would like the animation to be the same size as the original input image(s).

The animation will be named the same as the source image. If you would like to change this name, continue

with the next step, otherwise continue with step 12.

10. Select Advanced Options.

You will be presented with the Advanced Animation Options dialog box. Under Output options, you will see the name of the source image entered as the Sequential Files Prefix.

11. Replace the file name with the desired file name and click OK. You are now returned to the Animation Options dialog box.

12. Click OK.

The animation will now be processed. This will take a few moments depending on the number of frames you have requested.

When the animation process is concluded, the appropriate animation player will be launched depending on which option you chose in Step 2 above.

13. View the animation by clicking on the Play button.



## Saving and Retrieving Cutouts

Cutouts can be saved as image files or cutout files.

A cutout may be saved in a variety of file formats. To save a new image:

1. Choose [File/Save As/Save Image As](#). You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the image in the filename text box.
3. Select the desired file type.
4. Click OK.

### **To save the current cutout as a cutout file:**

1. Choose [File/Save A/Save Cutout As](#) and enter a filename for the cutout. You will be presented with the Save As dialog box.
2. Enter the name you want to assign to the cutout in the filename text box. Cutout files have the file extension .CUT. Cutout outlines, along with any animation frame information, is saved.
3. Click OK.

### **To retrieve a previously saved cutout:**

1. Choose [File/Open/Open Cutout](#).
2. Select the filename of the cutout you wish to use.
3. Click OK.

To go to any of the following topics, click on its title:



[Overview](#)



[Curve Fitting](#)



[Creating and Editing Cutouts](#)



[Creating Cutouts](#)



[Editing Cutouts](#)



[Cut](#)



[Copy Mode](#)



[Deforming](#)



[Mirror Horizontal or Vertical](#)



[Rotate Mode](#)



[Scale Mode and Size Mode](#)



[Re-Copy Mode](#)



[Restore Original](#)



[Quitting a Cutout Mode](#)



[Animating the Cutout](#)



[Saving and Retrieving Cutouts](#)

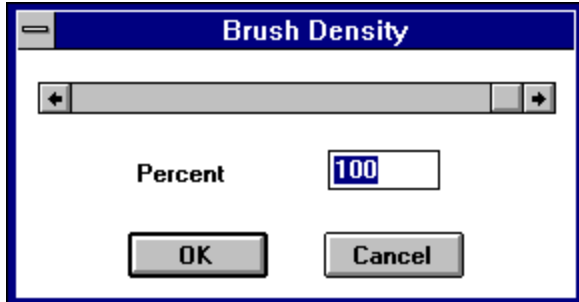
## **BRUSHES: Overview**

Digital MORPH's brushes are used to modify the color and texture of an image. There are seven brush types which will each be discussed in this chapter. In addition, there are three brush attributes that can be applied to the brush types to change their effect. The brush attributes are additive. This means that the brush, when applied to the image, will use all the attributes that have been enabled.

Let's examine each in turn.

## Brush Attributes

### Brush Density



This is a value, expressed in percent, that determines the degree to which the brush used will affect the image. The default density setting is 100%, meaning the full effect of the brush is seen while brushing.

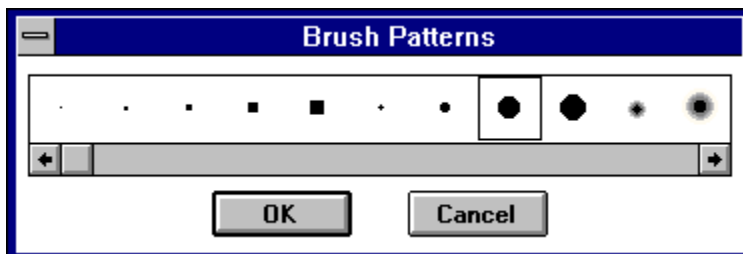
It is easiest to explain density using the color brush although this attribute can be applied to almost all the brushes. The color brush applies a color to the image wherever the brush is depressed. With a density of 100%, the brush will completely cover the underlying image with the selected color.

However, if the density is set to another value, say 50%, then the image area will be a combination of 50% brush color and 50% image color. Similarly, if the density is 25%, the result will be 25% brush color and 75% of the original color. Repeated application of the brush will eventually bring the color to 100% brush color. (See also "Tint Brush" in this chapter).



Brush density controls how much the brush type will affect the original image. At 100% density, a brush type will have the maximum affect, while any other percent will apply a lesser affect.

### Brush Patterns



The brush patterns vary from simple squares and circles to air brushes and speckled brushes. The brushes fall into two basic categories: binary and blended.

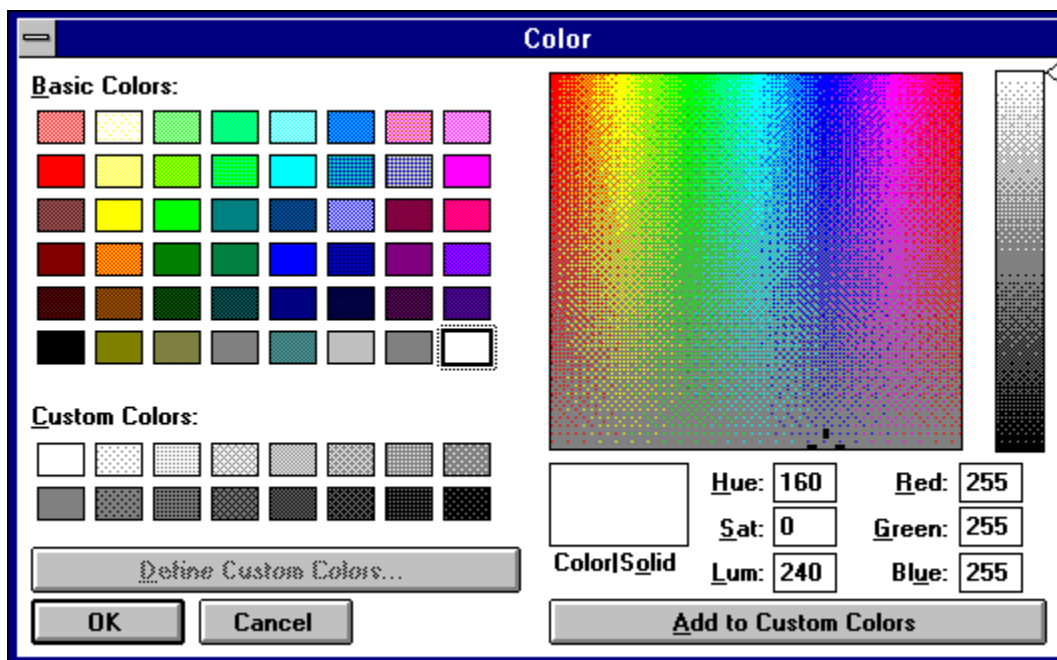
Binary brushes, such as squares, circles, lines and speckles are applied only where the brush

pattern occurs, such as inside the circle, or only at the dots of a speckled brush. Anywhere else, the screen image is left unchanged. Where the brush is applied, it is applied at the current brush density (see Brush Density).

Blended brushes, on the other hand, smoothly blend into the images as they are applied. The circular air brushes are blended brushes. They will be applied more strongly at the center than at the edges. This can be seen by the varying gray tones represented when selecting the brush patterns. The darker the tone, the more strongly the effect is at that point.

The total effect is also governed by the current brush density. If the density is 100%, then the brush's maximum effect will be seen on the screen as it is applied. If the density is 50%, for example, then only 50% of the effect will be seen. In other words, the density controls the overall brush application strength. Rather nice effects can be seen by using an air brush at about 50% density.

## Brush Color



If the basic color palette doesn't offer the color you want, you can create it with the custom colors palette. The dialog box has an interactive color grid (color refiner box) for mouse-controlled color selection, a scroll bar (vertical luminosity bar), a color/solid display box, and a series of increment boxes for fine-tuning. To use the Custom Color Selector dialog box, move the pointer to a spot on the color grid and click. Notice that a dashed crosshair (color refiner cursor) moves to that spot. The color you select will appear in the color/solid display box as both a color pattern and a solid.

To the right of the color grid, you'll see a scroll bar with a

triangular slider. To change the brightness or intensity of the color, click and drag the triangular slider. Alternatively, you can point anywhere on the scroll bar and click to move the slider to that position. For finer detail, you can use the up and down arrows on the increment boxes below the color grid to increase or decrease the settings for Hue, Sat (saturation), Lum (luminosity or brightness), Red, Green, and Blue. These settings automatically change with the movement of the crosshair or slider.

After you have found the right color, you can add it to the custom colors palette by selecting the Add to Custom colors button. You can add a color to each of the 16 selection boxes in the custom colors palettes.

## Brush Types

### Area Brush

The area brush is used to pick up the color from an area in an image to use elsewhere in the image. If the brush is larger than one pixel, this would be a set of colors.

Area brushes are useful for changing facial features. For example, to remove wrinkles, select an area near the area to affect. Then, by using a subtle brush density, paint the area over the wrinkles. When properly applied, and with an appropriate brush pattern, the wrinkles will gradually be removed. Another good use of the brush would be to trim off noses, chins, etc. from a side view of the face. Select the area just outside the nose, for example, then paint along the edge until the amount of the nose to be removed is gone.

If using a rectangular brush pattern, the area grabbed would be the rectangle under the brush. Then, each time the brush is applied, this same area would be deposited under the rectangular brush. The area selected will be non-rectangular if the brush has a more complex pattern. If the brush pattern were a speckled pattern, then only each dot of the speckle would pick up the area underneath. Likewise, painting only occurs under each dot of the speckle pattern. With a blending brush, the area under is retrieved as is. However, when painting, it is deposited at the strength of the brush at each point of the brush pattern.

Area brushes and pull brushes are similar. However, an area brush differs from a pull brush in that once the area is selected it is remembered until another area is chosen. A pull brush gets a new area each time the mouse button is lifted, while the area brush gets an area only when you depress the right button over the area.

As with all brushes, the strength of the brush depends upon the brush density.

#### **To use the area brush:**

1. Choose the brush pattern and density first.
2. Choose [Brush/Area](#).
3. Move the brush to the area to pick up a color, click the right button.
4. Move the brush to the area to paint; depress the

left button. The area can be deposited repeatedly by holding the button while moving the mouse.

## **Blend Brush**

The blend brush is used to smooth parts of an image. It averages pixels under the brush pattern to smooth them.

This type of brush has many uses. One frequent use is to smooth the jaggy edges of an image. For example, if a cutout were pasted into the image, the edge might look a little jaggy. If this is the case, use the blend brush to smooth out the edge.

This brush could also be used to help modify facial images. Again, a good example might be wrinkle removal. Simply brush over the wrinkles repeatedly until they disappear.

When using this brush, be aware that it may paint a little slowly. This is because of the many calculations involved. A blending pattern will calculate slower than a non-blended pattern. Also, the larger the brush, the slower it will be.

### **To use the blend brush:**

1. Choose the brush pattern and density first. Note that blend patterns (with gray tones) will brush slower than other brushes.
2. Choose [Brush/Blend](#).
3. Move the brush to the area to blend and depress the left button. The area can be blended repeatedly by holding the button while moving the mouse.

## **Color Brush**

The color brush is the simplest brush. It merely paints the chosen color at each point of the pattern.

### **To choose a brush color:**

1. Choose [Brush/Brush Color](#). The color palette will appear.
2. Select the desired color.

OR



1. Position the brush (cursor) over a color in the image.
2. Click with the right mouse button. The brush will pick up the color under the cursor.

When using a blending pattern, color brushes paint at the relative intensity of the tone at each point of the pattern. Darker parts of the pattern paint "heavier" than lighter parts. This means that the color is combined with more emphasis on the brush color rather than the underlying image color. In contrast, lighter parts of the brush pattern allow more of the original image color under it to show through, depending on density settings.

#### **To use the color brush:**

1. Choose the brush pattern, color, and density first.
2. Choose [Brush/Color](#).
3. Move the brush to the area to paint and depress the left button.

An area can be painted by holding the button while moving the mouse.

#### **Pull Brush**

A pull brush copies an area underneath it and then deposits it as the brush is moved.

#### **To use the pull brush:**

1. Choose the brush pattern, color, and density first.
2. Choose [Brush/Pull](#).
3. Move the brush to the area to pull, press and hold the left button while moving the mouse.

The area under the brush when the mouse is clicked will be the pulled area. A new area is pulled whenever the mouse button is released and pressed again.

The pull brush and area brush are similar. See Area Brush in this chapter.

#### **Tint Brush**

The tint brush is used to tint areas of the image. Tinting

can also be accomplished by using a color brush with the density set less than 100%. However, the tint brush has some special processing that preserves image information in a way that the color brush cannot.

The tint color is selected independently of the normal brush color. A separate Tint Color menu is used, and the tint color value is saved as well as the regular brush color.

The tint color, when applied, follows these rules:

If the color is other than white or black, the original image brightness is preserved when the color is applied. For example, if tinting with pure red, repeated application would eventually turn that part of the image red, but you would still see the image features underneath. The brightness of this part of the image would not be brighter than the original, even though a pure 255,0,0 red was used.

In contrast, a normal color brush would eventually bring the area to pure red, possibly much brighter than the original.

If the color is pure white, then the image is simply "lightened up" wherever the brush is applied. The original color is both desaturated and brightened. A good use for this brush is to whiten teeth.

### **To use the tint brush:**

1. Choose the brush pattern and density first.
2. Choose the tint color with [Brush/Tint Color](#).
3. Choose [Brush/Tint](#).
4. Move the brush to the area to tint and depress the left button.

An area can be tinted by holding the button while moving the mouse.

### **Undo Brush**

The undo brush is a special brush used to undo an area under the brush (remove the effect of a previously used brush). This differs from selecting Edit/Undo which will undo the entire screen. Selective area undo is accomplished by using the undo brush.

The undo reverts all the way back to the original image

wherever this brush is used.

**To use the undo brush:**

1. Choose a pattern for the undo.

The brush color and density are ignored.

2. Choose [Brush/Undo](#).

3. Move the brush to the area to undo and depress the left button.

An area can be undone by holding the button while moving the mouse.

To go to any of the following topics, click on its title:



[Overview](#)



[Brush Attributes](#)



[Brush Density](#)



[Brush Patterns](#)



[Brush Color](#)



[Brush Types](#)



[Area Brush](#)



[Blend Brush](#)



[Color Brush](#)



[Pull Brush](#)



[Tint Brush](#)



[Undo Brush](#)

## **ANIMATION: Overview**

Animation is the art of creating motion from still images. Digital MORPH allows you to animate its morphs, warps, and cutouts. The resultant animations are saved as either Autodesk Animator (.FLC) files or Video for Windows (.AVI) files.

We have, as part of the installation process of Digital MORPH, provided you with the means to play both of these file types. You will see, in the Digital MORPH Windows program group, an icon for the Autodesk Animation Player for Windows and an icon for an updated version of the Microsoft Windows Media Player. The Autodesk Animation Player for Windows allows playback, merging, linking with audio, and a variety of editing functions. The Microsoft Windows Media Player is a playback mechanism only and provides no editing capabilities. You will need the full retail version of Microsoft's Video for Windows program which contains the VidEdit utility to manipulate .AVI files.

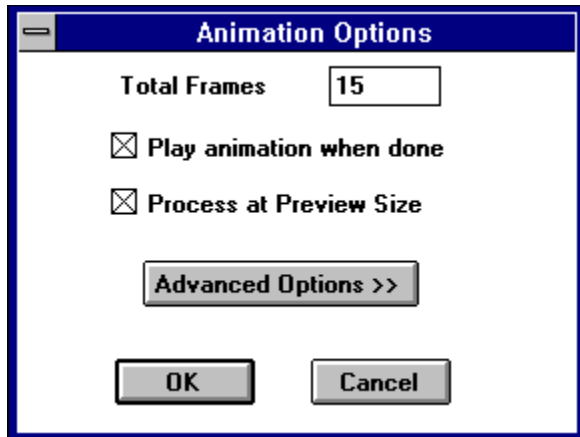
You choose the file format that you wish to use for exporting your animations (.AVI or .FLC) with File/Preferences/Export Format.

## Creating Basic Animations

The procedures for creating an animation of a morph, warp, or cutout are described in Chapters 2 through 4 respectively. The Animation Options and Advanced Animation Options windows that appear allow you to enter information about how the animation is to be processed.

The following two sections describe the functions of the Animation and Advanced Animation Options.

## Animation Options



### Total Frames

Total Frames refers to the number of single still images that will comprise your completed animation. Film and television animations use a playback rate of 30 frames per second to achieve motion. Thus, 30 frames would provide one second of playback.

In the computer world, this frame rate is not (yet) widely used. The processing power needed to display 30 frames per second full screen on your computer monitor is not available in the average PC today.

This brings up an important point about Digital MORPH and your particular PC. Morphing, warping and animating all require intensive mathematical calculations. For this reason, a higher-end machine (486DX) will perform these functions much more rapidly than a 386 system. If you do have a 386, a math co-processor would be of great assistance.

This does not mean that you MUST upgrade to a 486DX to enjoy faster performance. In many cases, the addition of more RAM is sufficient. A 486DX with 4MB of RAM may not necessarily outperform a 386DX with a math co-processor and 8 or 16 MB of RAM. In today's computing environment you can never really have enough RAM.

The compromise used to achieve acceptable motion video on your PC is a frame rate of 15 per second at about one-quarter screen resolution. This smaller viewing window and lesser frame rate require less processing horsepower. Even with a 486, this will be about the maximum throughput you can expect without using special compression techniques (more on that later).

It is also important to realize that the number of frames you choose to have generated is not necessarily how many frames per second you will see, but instead denotes the total number of frames in the animation file. Depending on the speed of your system, 30 frames may last 2 seconds or 10 seconds. You will need to experiment and adjust accordingly. A lower number of frames will often result in smoother playback.

## **Play Animation When Done**

When this option is chosen, the animation will be generated and the appropriate player will be launched automatically so that you can view the result.

If the Play Animation When Done option is not enabled, rather than creating a .AVI or .FLC file, a series of sequentially numbered still images is generated. In other words, instead of creating a motion file, each frame of the animation will be written out as a separate file. This allows you to edit individual frames, insert or delete frames, or join frames from another animation. Some very cool effects can be achieved in this manner. Once you have manipulated the individual files, you can then put them back together in an animation with the File/Export Sequential Files option.



This function is tied to the Deleted Exported Sequential Files option found in the Export Sequential Files menu. The default setting is on. If you toggle the setting off, you will generate both the animation file and the sequential files.

## **Process at Preview Size**

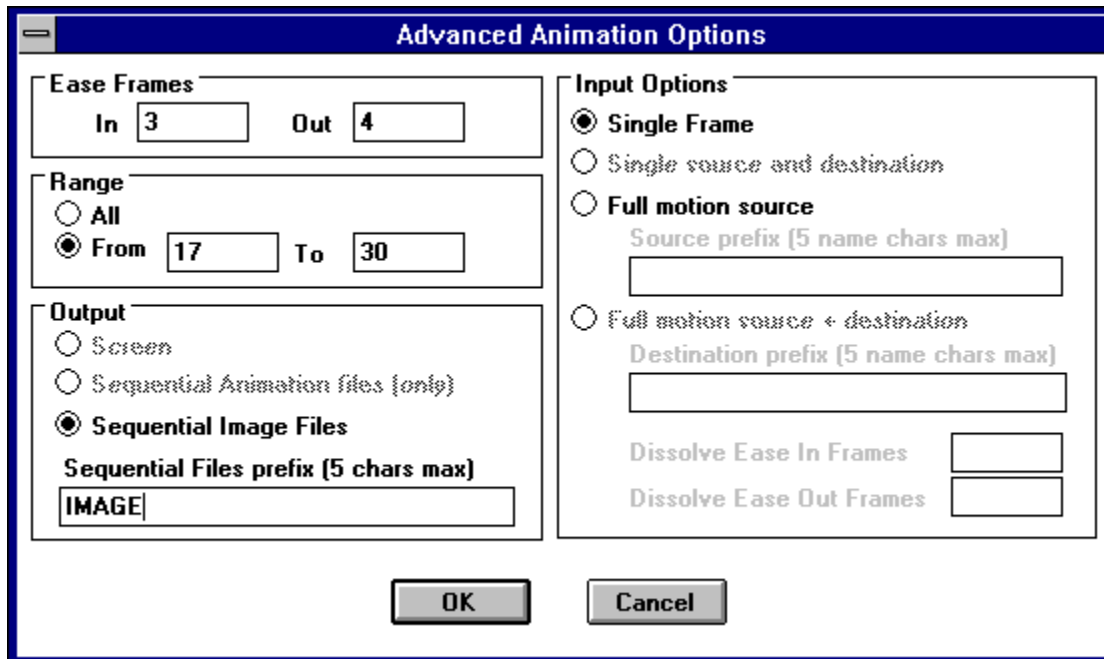
Preview mode allows you sample your animation at a reduced size before devoting the processing time to animating at full-image size. A quick check of your animation at a small size will help you determine if the parameters you have set will give you the results you desire.

The preview size is adjusted with File/Preferences/Preview Shrink Factor. The default shrink factor is 4 which represents a reduction to one-quarter size. The shrink factor is selectable from 1 (a one-to-one ratio or no size reduction) to 32 (the image is shrunk to one thirty-second of its original size).



## Advanced Animation Options

The Advanced Animation Options dialog box is accessed from the Animation Options dialog box. This is the place where you will set file names, ease frames, range control and input options.



### Ease Frames

This function controls the field lines when morphing, the grids when warping, and the cutout boundaries when manipulating a cutout. Easing in an out means setting a number of frames at the beginning and/or end of an animation that will be affected more gradually by the morphing process. Rather than the morph occurring at an even rate over the entire range of frames, the animation "eases" into the morph by having the specified number of frames of the source begin their morph at a decreased rate. Likewise, at the end of the animation, you can ease out by designating several frames during which the morphing process is lessened.



Note: Total ease-in and ease-out frames cannot be greater than the total number of frames.

### Range

Range allows you to determine how many frames will be animated. You can generate all frames or specify a range in the From and To boxes. If you have previously

generated a series of still images (as explained above in Play Animation When Done), you can now select how many of the individual still frames will be included in the animation.

## Output: Screen

When selected, the frame or frames will be displayed, but not written to a file.

## Sequential Animation Files Only

This option is used when morphing or warping full-motion animations. When selected, only the field (.FLD) or grid (.GRD) files (depending on which process you are animating) will be saved. No images files are created.



Note: The Screen and Sequential Animation Files Only choices will be grayed out if you have chosen Play Animation When Done in the previous menu. Sequential Image Files is the only option available if automatic playback is requested.

## Sequential Image Files

This option is available for users who are creating still images from an .AVI or .FLC animation to be subsequently used for applications such as professional video output. When this option is selected, the frames and animation information are saved in individual image files which will be sequentially numbered. The default five-letter prefix of the numbered files will be the first five characters from your source file. For example, if your source image is the file EAGLES.BMP, the output frames EAGLE000, EAGLE001, EAGLE002, etc. would be generated. You can change the name of the output files by entering up to five letters in the box.



Note: The image format (and corresponding file extension) is selected with File/Preferences/Image Types. The default is Windows BMP 8 bit (.BMP).

## Input Options

These options are set automatically depending upon your choice of source and destination images. The appropriate choice will be made for you and the inappropriate selections will be grayed out. For example, if you are working with one image, the Single Source and Destination and Full Motion Source and Destination choices will be grayed out as they refer to

Two Image mode.

### **Single Frame**

A single still image is used in the morph, warp, or cutout.

### **Single Source and Destination**

Two distinct still images are used as the source and destination.

### **Full Motion Source**

The source file is the first in a series of sequentially numbered files.

### **Full Motion Source and Destination**

The source and destination are both a series of sequentially numbered files.

The two full-motion selections additionally allow you to specify a new name for the output files if you wish something other than the default which is ANIM.

### **Dissolve Ease In and Out Frames**

This selection controls the dissolve rate of selected frames when blending two images together in a morph or warp. It operates independently of the Ease Frames function.

## Creating Full-Motion Animated Morphs and Warps

In addition to working with still images, you can also morph and warp full-motion images (animation files in the .AVI or .FLC format). The idea here is that you can unpack an animation file into a series of individual images or frames, morph or warp these frames, then pack these frames back into an animation file. The frames must be sequentially numbered (e.g., eagle01.bmp, eagle02.bmp). To accomplish this with .AVI files, use the VidEdit utility that comes with Video for Windows. VidEdit has an extract feature that works with (unpacks) .AVI files. You will need Autodesk Animator to extract files from a .FLC file.

This example assumes you are working with a morph and are in Two Image mode. The same procedures will work for a warp. Before beginning, you must have already created the source and destination sequential files either manually or by extracting them from .AVI or .FLC files as described above.

1. Choose [File/New Morph](#).
2. Open the first of your sequentially numbered source .BMP files.
3. Respond Yes to the prompt: Do You Want to Morph Between Two Images?.
4. Open the first of your sequentially numbered destination files.
5. Respond Yes to the prompt: Number Found in File Name. Use Sequential Files for Full Motion Live Action?.
6. Enter Field Lines on the source image.
7. Choose [Entry/Save](#). You will be taken from the Field Lines Entry screen to the three-window interface.
8. Double-click on the Destination window to move the destination image into the Working window. Adjust the points on the destination image.
9. Choose [File/Animate/Animate Morph](#).
10. Toggle Play Animation When Done off.
11. Click on the Advanced Options button.
12. Select Sequential Animation Files Only as your

output.



Note: The input parameters and file names are entered automatically. These file names usually do not need to be changed. The default output prefix, which may be changed, is ANIM.

13. Enter values in the Ease Frames boxes if you wish this effect. Specify the Range of frames to be used. The default is All.

14. Click OK to go back to the Animation Options menu. Click OK again to exit the Animations Options menu.

The field files (.FLD) for each of the source and destination images in the sequence will be quickly generated as no processing of images is done. The fields for all the files in the sequence will be saved to the hard disk as sequentially numbered .FLD files.

15. Choose [File/Save Morph](#). The field lines you entered for the first source and destination files will be saved.

16. Choose [File/Close](#) to remove these two images and allow you to begin working on the next pair.

You must use File/Save and then File/Close after adjusting the points on each pair of images. If you do not close, you will be overlaying new field lines over the previous images. Field files are linked to images, but if you have an image on screen already, the field lines will be overlaid on the current image. If you have no image on screen, the appropriate image will be displayed when you open the .FLD file. Digital MORPH works in this way to allow the use of a set of field lines with any image.

17. Choose [File/Open Morph](#).

18. Select the second of the .FLD files generated in the steps above.

19. Adjust the field lines on both the source and destination images.

20. Choose [File/Save](#) and [File/Close](#).

Continue this process for each successive .FLD file. When you have finished adjusting the field lines for each pair of source and destination images, it will be necessary to repack the still images into an animation file. This procedure is explained in the following section.

## Exporting Sequential Files

During the full-motion morphing procedure described in the previous section, two .AVI or .FLC files, one for the source and one for the destination, were unpacked into a sequence of individual frames and field lines were adjusted on each pair of frames in the sequence. Now, to create the final animated morph sequence from one full-motion file to another, you must pack these individual files together again using the Export Sequential Files option.

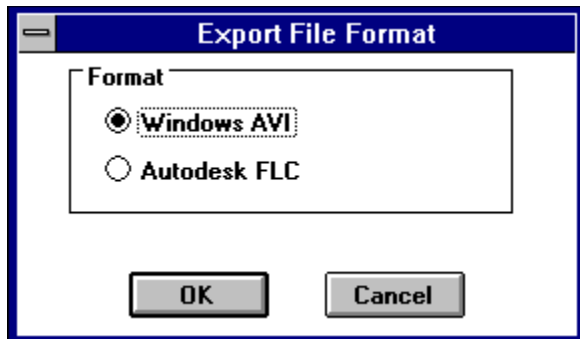
The following procedure applies to warps, as well.

1. Choose [File/Open/Open Morph](#) to open the first .FLD file.
2. Choose [File/Export Sequential](#).

From the Export/Play Options dialog box, you can now select the type of animation you want to export (.AVI or .FLC). You can also choose to delete the individual .FLD files after they are exported (packed) into the animation file and whether or not you want to automatically launch the appropriate animation player.



The sequential files, once exported are usually not needed anymore.



3. Click OK.

## Linking Animations

Animations of morphs can be linked together to create successive morphs;

e.g., a butterfly changes to a bird and then to an airplane. This is achieved by animating an initial morph between two images (e.g., butterfly to bird) and then linking an animation comprised of a second morph between the destination image of the first morph and a new graphic (e.g., bird to airplane). The field lines from the first morph are saved and then laid over the images in the second morph. This process can be repeated infinitely to create a mega-morph movie marathon!

The actual linking of the animations is not done in Digital MORPH, but rather in either the Autodesk Animation Player (if you save your animations as .FLC) or Video for Windows (for animations saved as .AVI).

The following procedure applies to linking warp animations as well as morph animations. To link the animations:

1. Select the images: one as the source (the butterfly in our example), one as the intermediate image which will be the destination image for the first morph and the source image for the second morph (the bird), and the final destination image (the airplane).
2. Create and animate the first morph as explained in Chapter 2.
3. Choose [File/New Morph](#).
4. Select as the source image the destination image from the first morph (bird).
5. Respond Yes to the prompt: Do you want to morph between two images?.
6. Select your new destination image (airplane).
7. When the Morph Field Lines Entry screen appears, choose [Entry/Close](#) and respond Yes to the prompt: Lose entry.
8. Choose [File/Open Morph](#).
9. Open the .FLD file created from the previous morph: butterfly to bird. The field lines will be overlaid on your new images (bird and airplane).

10. Choose [Morph/Swap Destination and Source Fields](#). The field lines for the source image should now be correct and you now have only to adjust the field lines on the destination image.
11. Animate this morph as you have done previously.
12. Now use Video for Windows or Autodesk Animator to link the resultant animations together.

In general, animations of morphs have a smoother look if you use the Ease In/Ease Out frames selection in the Animation Options/Advanced Animation Options dialog box. Easing in and out gives the viewer time to see the source and destination images. Rather than the morph occurring at a linear rate over the number of frames in the animation, the ease frames will show a lessened degree of morph. When linking animations, this feature can make for smoother transitions between the individual morph animations.



## Animation Playback

Digital MORPH allows you to save animation files as either Video for Windows .AVI files or Autodesk Animator .FLC files. As you are working, you are given the choice of launching the appropriate player to check your work. You will, of course, want to use the players again to display your completed animations as part of presentations, demos, etc.

The file format you choose to use is a matter of personal taste and needs.

If you are handy with Autodesk products such as Animator or 3D Studio and/or

don't have Video for Windows, then you will most likely prefer to use .FLC files.

If you have Video for Windows and are familiar with the VidEdit utility, you should save your files as .AVI.

## Video Compression

Microsoft's Video for Windows has the added benefit of allowing you to use a variety of compression algorithms that can significantly reduce file sizes and produce smoother playback. The trade off is degradation of image quality, depending on the level of compression and algorithm used. Video for Windows ships with several compressors and there are also third party compressors available. Intel's Indeo driver is one of the best available for maintaining good image quality while providing high levels of compression.

To go to any of the following topics, click on its title:



[Overview](#)



[Creating Basic Animation](#)



[Animation Options](#)



[Total Frames](#)



[Play Animation when Done](#)



[Process at Preview Size](#)



[Advanced Animation Options](#)



[Ease Frames](#)



[Range](#)



[Output](#)



[Sequential Animation Files Only](#)



[Sequential Image Files](#)



[Input Options](#)



[Single Frame](#)



[Single Source and Destination](#)



[Full Motion Source](#)



[Full Motion Source and Destination](#)



[Dissolve Ease In and Out Frames](#)



[Creating Full Motion Animated Morphs and Warps](#)



[Exporting Sequential Files](#)



[Linking Animations](#)



[Animation Playback](#)



[Video Compression](#)

## ADVANCED TOPICS: 256 Color VGA Notes

256-color VGA boards can be used with Digital MORPH. Using reasonable care with 256 color boards can result in good image quality. However, the best image quality is obtained with boards that support at least 32,000 colors.

Using a single image with 256 colors is not usually a problem. The source image should either be preprocessed down to 236 colors (see next paragraph), or should be available as a full color (24-bit) file. Many software packages on the market today produce very good quality 256 color images from full-color 24-bit image files. Digital MORPH can process a full color image down to 256 colors, but its quality may not be as good as those done by specialty software just for that purpose. Digital MORPH will select the "best" 256 colors to represent the image.

If you import a 256-color image and find areas that appear to use "odd" colors (such as purest white in areas that should be a lighter white), the problem is with the processing software. Windows reserves 20 colors for menus, title bars, dialog boxes, and so on. These colors should not be used by color images, or else the artifacts just described will appear. The solution is to process the image down to 236 colors, not 256. This leaves the 20 colors for Windows for use by Windows only. If your software cannot do this, Digital MORPH can process full color 24-bit images for you. Digital MORPH always processes down to 236 colors so that artifacts will not appear.

When multiple images are involved, such as morphing between two different images, compromises have to be made. The problem is that the two 256-color images need to be displayed simultaneously, thus needing 512 colors when only 256 are available. Digital MORPH, along with the Windows operating system, attempts to resolve this conflict by matching colors as closely as possible. The active window will always have the priority and will display its full set of 256 colors, while the other windows will try to match as closely as possible. Note that although the non-active images may display with "odd" colors, the image itself is unaffected.

When the images are calculated, the internal calculations are always done in full color. When it comes time to display an image that has been calculated, a new set of 256 colors will be selected. This palette will also be saved to a file if the image is stored. This insures the best possible color when trying to blend two 256-color images together. Calculating in 24 bits does not add much additional time, and the resulting image quality is

well worth it.

These same rules apply to the use of cutouts in 256-color systems. If the cutout is "local" (from the same image, or has the same palette), then no color matching need be done, and the cutout will appear and paste as normal. However, if the cutout is from a different image, or has a different palette, a best match will be done, using the colors in the working image. While this will not affect the working image quality, it may adversely affect the cutout. The only solutions are to use an external program that can match color palettes between images or use a hi-color or true-color VGA card.

When using blending type brushes, tints, or density less than 100%, the closest possible color that already exists in the image is the color to be used. This may at times not be the color desired, but there are only 256 colors to choose from. Only a hi-color or true-color VGA display can remedy this.

When animating in VGA mode, note that a new 256 color table is used for each frame of the animation. You may wish to use your animation editor or player program to optimize this. Some slower displays show a flicker as the animation is played when the new table for the next image is loaded.

Please note that all of the above discussion applies only to 256 color systems. 32,000+ color systems have none of these problems or drawbacks as there are enough colors available at once to satisfy any number of images.

## Exporting Screens to Other Programs

Any image created in Digital MORPH can be exported to other Windows programs via the clipboard or through files.

### Export through the Clipboard

The clipboard image will be the same resolution as the window size.

1. Activate the window with the image to export.
2. Select [Edit/Copy All](#).
3. In the application, select Edit/Paste to insert the image.

### Import from the Clipboard

Images may also be retrieved from the clipboard.

1. Select [Edit/Paste All](#).
2. The entire image will be imported into Digital MORPH.

To go to any of the following topics, click on its title:



[256 Color VGA Notes](#)



[Exporting Screens to other Programs](#)



[Export through the Clipboard](#)



[Import from the Clipboard](#)



## **File Formats: Overview**

Digital MORPH uses a variety of file formats. There are two basic types of files: image files and Digital MORPH files.

Image files and their formats are generally binary and contain information necessary to display an image on the screen. Digital MORPH supports a wide variety of these formats to accommodate the various other applications on the market. Since there are so many different formats, it is impossible to cover them all here. However, you will find specific notes about some of them relative to Digital MORPH.

Digital MORPH's files are all standard text files. The information contained in these files is used by Digital MORPH to execute the various processes (morphing, warping, animation, etc.). The files can be viewed and changed with a text editor such as Notepad, but it is not recommended that you do so unless you are very certain of what you are doing. Even advanced users can cause a cascade of errors by entering wrong information into the files.

## Digital MORPH File Formats

### Cut files (.cut)

Cut files (.cut) contain information about a cutout. The file contains both the source and the destination cutout outlines, along with any animation frame information. Specifically, it is formatted as follows (each line here is a new line in the file):

PointCount	integer counts
ClipCurveSegments	
xSrcCutPt1 ySrcCutPt1	floating point numbers a neg (-) is a penup
xSrcCutPtn ySrcCutPtn xDestCutPt1 yDestCutPt1 .xDestCutPtn yDestCutPtn	floating point numbers
ClipFilename	name of the file that has the bitmap
ANIMATESTART	this is literal text that must appear
TotalFrames	int
Easin EaseOut DissolveEaseln DissolveEaseOut SourceImage=	source image file
ANIMATEEND	this is literal text that must appear

### Field files (.fld)

Field files (.fld) contain information about morph field lines. The file contains both the source and the destination field lines, along with any animation frame information. Specifically, it is formatted as follows (each line here is a new line in the file):

A B P FreezeEdges	(floating point morph parameters)
FieldCount	integer count
xSrcFieldPt1 ySrcFieldPt1	floating point numbers (a neg (-) is a penup)
xSrcFieldPtn ySrcFieldPtn xDestFieldPt1 yDestFieldPt1 xDestFieldPtn yDestFieldPtn	floating point numbers
LocalMorph	1 for local morphing, 0 if full screen

<b>ANIMATESTART</b>	this is literal text that must appear
<b>TotalFrames</b>	int
<b>Easin EaseOut</b>	
<b>DissolveEaseIn</b>	
<b>DissolveEaseOut</b>	
<b>SourceImage=</b>	source image file name
<b>DestinationImage=</b>	destination file name
<b>ANIMATEEND</b>	this is literal text that must appear

## Grid files (.grd)

Grid files (.grd) contain information about warp grids. The file contains both the source and the destination grids, along with any animation frame information. Specifically, it is formatted as follows (each line here is a new line in the file):

<b>GridWidth GridHeight</b>	int
<b>xSrcGridPt1 ySrcGridPt1</b>	floating point numbers
<b>xSrcGridPtn ySrcGridPtn</b>	varys across first, then up
<b>xDestGridPt1 yDestGridPt1</b>	floating point numbers
<b>xDestGridPtn yDestGridPtn</b>	varys across first, then up
<b>ANIMATESTART</b>	this is literal text that must appear
<b>TotalFrames</b>	(int)
<b>Easin EaseOut</b>	
<b>DissolveEaseIn</b>	
<b>DissolveEaseOut</b>	
<b>SourceImage=</b>	source image file name
<b>DestinationImage=</b>	destination file name
<b>ANIMATEEND</b>	this is literal text that must appear

## DIGIMORF.INI

The file "digimorf.ini," found in the Windows directory (usually c:\windows) contains the settings for Digital MORPH. Most of these are set through the Preferences menu, and should not be modified with a text editor unless great care is taken. To return to a default state, simply delete the file then exit and restart Digital MORPH again. Below are relevant entries in the file, and the default setting is listed:

FLC_Player=aawin	This is the name of the executable application used to play back .FLC files. Path and drive information can be included, otherwise, it is assumed that the player named is in the path.
AVI_Player=mplayer	This is the name of the executable application used to play back .AVI files. Path and drive information can be included; otherwise, it is assumed that the player named is in the path.
LocalMorph=1	1 if local morph is to be enabled upon startup, 0 if not.
LocalWarp=1	1 if local warp is to be enabled upon startup, 0 if not.
ZeroBased=1	1 if the first sequential file starts at 0, 0 if it starts at 1.
SourceFullSize=0	1 if the source window is to be displayed at the same size as the working window.
PreviewShrink=4	How much to shrink the preview by. The default, 4, will preview a 640x480 image to 160x120 (divided by 4).
Preview=1	1 if preview mode is to be enabled upon startup, 0 if not.
ExportType=1	1 for AVI, 2 for FLC.
FlipCMP=0	Flips .CMP files upside down upon reading. Useful for older .CMP files from other applications.
DitherType=0	Available dither types (256 color images): 0=No dither 1=Floyd-Stein 2=Stucki 3=Burkes 4=Sierra 5=Stevenson Arce
QFactor=2	JPEG compression factor, 2 to 255. 2 is

best image, least compression, with 255 as worst quality, best compression.

ImageType=11

Default image input and output file format. Types (the number refers to the number of bits stored):

1=TGA 8  
2=TGA16  
3=TGA24  
4=TGA32  
5=TIF 1  
6=TIF 8  
7=TIF 17  
8 = TIF 24  
9=Windows BMP 4  
10=Windows BMP8  
11=Windows BMP24  
12=Windows DIB4  
13=Windows DIB8  
14=Windows DIB 24  
15=OS/2 BMP 4  
16 = OS/2 BMP 8  
17 = OS /2BMP 24  
18= PCX 1  
19 = PCX 8  
20 = PCX 24  
21 = GIF  
22 = CMP  
23 = JFIF 4:1:1  
24 = JFIF 4:2:2  
25 = JTIF 4:1:1  
26 = JTIF 4:1:1  
27 = JPEG FIF  
28 = JPEG TIF  
29=- Windows Meta File (WMF) 1  
30=- Windows Meta File (WMF) 8  
31=- Windows Meta File (WMF) 24  
32 = EPS (Encapsulated Post Script)

cursorXOR=2

Cursor XOR value; 1 or 2

CursorColor=128 0 0

RGB cursor color

CurveSegments=3

Default curve segments between points.

1=no curve  
3=reasonable curve  
5 = good curve

## Image File Formats

Image files are stored in the default file format (set by Preferences/Image Types) no matter what extension is added. In order to keep track of the formats, it is recommended that the extension be added automatically when saving a file.

## JPEG File Types

JPEG is a compressed file format. There are two basic varieties, the FIF (File Interchange Format), or the TIF (Tagged Image File). To decide which JPEG to use depends on which file type is recognized by your other application(s). Unless you have a specific requirement for using JPEG, use the Compressed File Format .CMP supported by Digital MORPH, as no image quality is lost, and the files are smaller.

JPEG format is a variable format. This means that the file size depends upon the image quality preserved in the file. Generally, the smallest files have the worst image quality, and vice versa. The slider bar in the Preferences/Image Types dialog box sets this value.

## Compressed Files

There are two types of file compression that can be used to store the image files, JPEG (see JPEG File Types{\relate "FILEFMT.DOC!D2HRB20"}) and Compressed.



Compressed files (.CMP) are a Leadview file format is incorporated into it. Digital MORPH fully supports the .CMP format, as it produces very small, high quality image files. If you intend to store a lot of files on your disk, it is recommended that you use this format. If you need an image in another application, either save the file in a different format or copy it through the clipboard.

## Windows System Files

### WIN.INI

The following changes will be added to the Windows WIN.INI file. The existing WIN.INI file will be saved as WIN.HSC.

#### [mci extensions]

avi=avivideo  
fli=animation1  
flc=animation1

### SYSTEM.INI

The following changes will be added to the Windows SYSTEM.INI file. The existing SYSTEM.INI file will be saved as SYSTEM.HSC.

#### [mci]

animation=mciaap.driv  
AVIVideo=mciavi.driv  
Animation1=mciaap.driv

#### [drivers]

VIDC.MSVC=msvidc.driv  
VIDC.RT21=msvidc.driv

To go to any of the following topics, click on its title:



[Overview](#)



[Digital Morph File Formats](#)



[Cut Files \(.cut\)](#)



[Field Files \(.FLD\)](#)



[Grid Files \(.GRD\)](#)



[DIGIMORF.INI](#)



[Image File Formats](#)



[JPEG File Types](#)



[Compressed Files](#)



[Windows System Files](#)



[Win.ini](#)



[System.ini](#)



## Menu Commands: File Menu

### Command

New Image  
New  
Cutout  
New  
Morph  
New Warp

### Purpose

Creates a new image.  
Starts a new cutout.  
  
Starts a new morph.  
  
Starts a new warp.

### Open

Open  
Image

Creates a new image.

Open  
Cutout

Opens a previously created cutout.

Open  
Morph

Opens a previously created morph.

Open Warp

Opens a previously created warp.

### Close

Close's all open images, warps, morphs and cutouts.  
If any changes were made, you will be prompted to save the appropriate item. A No response will not save, while a Cancel response will cancel the request completely, leaving the item intact.

### Save

Save  
Image

Save changes to an existing image.

Save  
Cutout

Save changes to an existing cutout.

Cutout files have the file extension .CUT. Cutout outlines, along with any animation frame information, is saved.

Save  
Morph

Save changes to an existing morph.

Morphs are saved as Field files (.FLD). Field files contain information about morph field lines. The file contains both the source and destination field lines, along with any animation frame information.

Save Warp

Save changes to an existing warp. Warps are saved as Grid files (.GRD). Grid files contain information about warp grids. The file contains both the source and destination grids, along with any animation frame information.

### Save As

Save  
Image As

Save and names an image for the first

	time. Or, saves and renames an existing image.
Save Cutout As	Save and names a cutout for the first time. Or, saves and renames an existing cutout.
Save Morph As	Save and names a morph for the first time.  Or, saves and renames an existing morph. Morphs are saved as Field files (.FLD). Field files contain information about morph field lines. The file contains both the source and destination field lines, along with any animation frame information.
Save Warp As	Save and names a warp for the first time.  Or, saves and renames an existing warp. warps are saved as Grid files (.GRD). Grid files contain information about warp grids. The file contains both the source and destination grids, along with any animation frame information.
<b>Print</b>	Prints a graphic file.
<b>Preferences</b>	
Curve Fitting	Grid Line, either in warp or cutout mode, can either remain straight, or become curved. This is controlled by either disabling or enabling curve fitting, respectively. Curve fitting will take a little longer to process, but should produce better looking images because that portion of the image will curve, too.
Dither Type	When using a 256-color display, any image with greater than that number of colors will have to be reduced to 236 colors as previously described. This reduction can occur in one of two ways: by optimization or by dithering. Optimization is done when no "dither type" is selected. The colors are counted, and the most frequent colors are used when optimizing. On the other hand, dithering will use a set color palette and then dither ("mix") the colors visually to simulate more colors. Sometimes it is necessary to experiment with the various dither types in order to produce an acceptable image. To do so, simply set the dither type, close, then re-open the file.  When using Two Image mode, it may be

	<p>preferable to use dithering instead of optimization to reduce color degradation. A window smaller than full size will sometimes exhibit artifacts when scaling a dithered image. This is normal, and only affects the view of the image in that window.</p>
Export Format	<p>Defines the type of file an animation will be saved as.</p>
Image Types	<p>Defines the image type that an image will be saved as.</p>
Leading Zeros	<p>Determines if zeros will be added to the file names of sequential files.</p>
Preview Shrink Factor	<p>Because creating morphs at full screen can take a few moments to process, a preview mode is available. The preview mode will process a smaller copy of the image, thus saving time. After the process, the Working window will display the result as a smaller image.</p> <p>A prompt will appear asking for a value of one through 32. A value of 1 will give a preview size that is equal to the original image. A value of 2 will give a preview that is one-half the size of the original image, a value of 3 will give a preview that is one-third the size of the original image and so on. The default setting is 4, giving a preview that is one-quarter the size of the original image.</p>
Zero as First Frame	<p>Allows the first frame of a sequence of frames to have file name end in a zero rather than a one. Some programs that allow the importation of sequential image files require the first frame to end in zero, and some require that the first frame end in a one.</p>
Animate Animate Cutout	<p>Creates an animation using the currently opened cutout. Animated cutouts can be saved as a Video for Windows .AVI file, an Autodesk .FLC file, or a series of individual image files.</p>
Animate	<p>Once field lines have been entered on the</p>

Morph

source and destination images, the actual morphing process can take place. An animated morph of the two people would produce a gradual transition between the two images over a period of time.

Animated morphs can be saved as a Video for Windows .AVI file, an Autodesk .FLC file, or a series of Individual image files.

Animate  
warp

Creates an animation using the currently opened warp.

Animated warps can be saved as a Video for Windows .AVI file, an Autodesk .FLC file, or a series of individual image files.

Export  
Sequential

Exports a sequence of image files to a Video for Windows video format or an Autodesk animation format.

Exit

Exits HSC Digital MORPH. Gives you the opportunity to save changes to the current cutouts, morphs, or warps

## Edit Menu

Command  
Undo

### Purpose

If you perform an action to produces unwanted results, this will remove or "Undo" that action.

Restore  
Original

Returns the image, morph, warp or cutout to a state before any action was taken on this image, morph, warp or cutout.

Save for  
Undo

Saves an image, morph, warp or cutout to a temporary file so that Restore Original will return to the desired state.

Copy from  
Cutout

Copies the area selected by the cutout tool to the Windows Clipboard.

Copy All

Copies the entire open image to the Windows Clipboard.

Paste to  
Cutout

Copies the contents of the Windows Clipboard to the current open image.

Paste All

Copies the contents of the Windows Clipboard to a new image.

## View Menu

The window(s) on the screen can be viewed in a variety of different ways. Note that the working window is always displayed at pixel size (unless zoomed). This means that you cannot view an entire image at once if its resolution is greater than the pixel size of the working window.

### Command Zoom In

### Purpose

Clicking this option enlarges the image. This is useful for detail work. The cursor will change to the zoom cursor. Click on the center of the area to become enlarged. There is no limit to how far the zoom can go.

### Zoom Out

If the screen has been zoomed, a click on zoom out will bring it back to the original image size, no matter how much it was zoomed.

### Instruction Bar

This toggles the view of the instruction line at the bottom of the screen. This instruction line gives directions on what command should be executed next. Experienced users may wish to turn off the line, which will create a larger workspace.

### Warp Grid Lines

This toggle controls the view of the warp grid lines. If toggled off, only the grid intersection points are visible. This is useful when the lines are too dense to see the image or the effect clearly.

### Destination Window

When using full screen warps or any morphs the destination window will automatically be on screen. The source window represents the original image (as loaded), and any warp grid or Morph Lines. The window can be removed by toggling it off. If using Two Image mode, the destination window will display the image associated with the file selected as the second image.

### Source Window

When using full screen warps or any morphs, the source window will automatically be on screen. The source window represents the original image (as loaded), and any warp grid or Morph Lines. The window can be removed by toggling it off. In addition, it is useful to view the source window while brushing or using cutouts. In this case, toggle on the window to have

it appear. If source at full size is toggled, the image will appear at the same position and size as the working window. The window can be updated during warp or morph editing by clicking once inside the window.

### Arrange Windows

Arranges the source, destination, and working windows to their original position so that all windows are visible.

### Before and After

This toggle is used to display the source and working images side by side. This is useful for printing images and comparisons. Most menu functions are disabled when viewing the composite image. Toggle it off to resume your work. In addition, if warping or morphing in Two Image Mode, the screen will display three images: source, working image, and destination .

### Source at Full Size

This toggle is used to display the source and working images side by side. This is useful for printing images and comparisons. Most menu functions are disabled when viewing the composite image. Toggle it off to resume your work. In addition, if warping or morphing in Two Image Mode, the screen will display three images: source, working image, and destination .

## Brush Menu

Digital MORPH's brushes are used to modify the color and texture of an image. There are seven brush types. In addition, there are three brush attributes that can be applied to the brush types to change their effect. The brush attributes are additive. This means that the brush, when applied to the image, will use all the attributes that have been enabled.

### Command Area

### Purpose

The area brush is used to pick up the color from an area in an image to use elsewhere in the image. If the brush is larger than one pixel, this would be a set of colors.

### Blend

The blend brush is used to smooth parts of an image. It averages pixels under the brush pattern to smooth them.

### Color

The color brush is the simplest brush. It merely paints the chosen color at each point of the pattern.

### Pull

A pull brush copies an area underneath it and then deposits it as the brush is moved.

### Tint

The tint brush is used to tint areas of the image. Tinting can also be accomplished by using a color brush with the density set less than 100%. However, the tint brush has some special processing that preserves image information in a way that the color brush cannot.

### Undo

The undo brush is a special brush used to undo an area under the brush (remove the effect of a previously used brush). This differs from selecting Edit/Undo which will undo the entire screen. Selective area undo is accomplished by using the undo brush.

### Brush Color

If the basic color palette doesn't offer the color you want, you can create it with the custom colors palette. The dialog box has an interactive color grid (color refiner box) for mouse-controlled color selection, a scroll bar (vertical luminosity bar), a color/solid display box, and a series of increment boxes for fine-tuning. To use the Custom Color Selector dialog box, move the pointer to a spot on the color grid and click. Notice that a dashed crosshair (color refiner cursor) moves to that spot. The color you select will appear in the color/solid display box as both a color pattern and a solid.



### Brush Density

This is a value, expressed in percent, that determines the degree to which the brush used will affect the image. The default density setting is 100%, meaning the full effect of the brush is seen while brushing.

### Brush Pattern

The brush patterns vary from simple squares and circles to air brushes and speckled brushes. The brushes fall into two basic categories: binary and blended. Binary brushes, such as squares, circles, lines and speckles are applied only where the brush pattern occurs, such as inside the circle, or only at the dots of a speckled brush. Anywhere else, the screen image is left unchanged. Where the brush is applied, it is applied at the current brush density (see Brush Density). Blended brushes, on the other hand, smoothly blend into the images as they are applied. The circular air brushes are blended brushes. They will be applied more strongly at the center than at the edges. This can be seen by the varying gray tones represented when selecting the brush patterns. The darker the tone, the more strongly the effect is at that point.

### Tint Color

If the basic color palette doesn't offer the color you want, you can create it with the custom colors palette. The dialog box has an interactive color grid (color refiner box) for mouse-controlled color selection a scroll bar (vertical luminosity bar), a color/solid display box, and a series of increment boxes for fine tuning. To use the Custom Color Selector dialog box move the pointer to a spot on the color grid and click. Notice that a dashed crosshair (color refiner cursor) moves to that spot The color you select will appear in the color/solid display box as both a color pattern and a solid.

## Cutout Menu

Cutouts are selected areas of an image that can be moved, scaled, rotated, flipped, and animated. Cutouts can be saved as a file or copied to and from the Windows clipboard. Only one cutout at a time can be defined and operated upon.

	Purpose
Command Cut	The area under the cutout will be set to the transparent color.
Copy Mode	Copies the current cutout selection to the location of the cutout.
Deform Mode	Deforms the cutout by allowing points of the cutout to be independently moved.
Mirror Horizontal	The Cutout/Mirror function allows the cutout to be flipped either horizontally or vertically.
Mirror Vertical	The Cutout/Mirror function allows the cutout to be flipped either horizontally or vertically.
Rotate Mode	Rotates the cutout either clockwise or counter-clockwise.
Scale Mode	Allows the horizontal or vertical size of the image to be changed.
Size Mode	Resizes the cutout.
Re_Copy Mode	This special mode allows you to fill an existing cutout's shape with a new portion of the image. For example, if the create a cutout and copy it to a new location, then choose Re-copy Mode from the Cutout menu, the cutout will now be filled with the image are that is under the cutout's new position. This then becomes a new cutout and operations such as scale and deform can be performed.
Restore Original	The cutout is returned to the original orientation and position.

## Morph Menu

Morphing is a technique used to give the illusion of one image melting into another. It is accomplished by defining areas on the first image (the source) that will be reshaped to match corresponding areas on the second image (the destination).

### Command Add Field Lines

### Purpose

Additional field lines can be added to the source image at any time during the morph creation process as one or more new source fields. It is not possible to add field lines to an existing source field.

### Edit Destination Field Lines

Selects the destination image to be the working image so that the destination Field Lines can be edited.

### Edit Source Field Lines

Selects the source image to be the working image so that the source Field Lines can be edited.

### Copy Source Fields to Destination

Copying source fields to the destination image will delete any changes to the field lines on the destination image. The result will be that both the source image and destination image will have identical field lines.

### Copy Destination FieldsTo Source

Replace the Field Lines in the source image with that of the destination image.

### Swap Source and Destination

To replace the source field lines with the field lines of the destination image and vice versa.

### Parameters

The parameters which fine tune the morph are set with Morph/Parameters. These parameters can have dramatic effects on the way morphing occurs. The default values are designed to work with a wide variety of images and most applications. If you should decide to vary these parameters, it is advised to do so one at a time to see the effect.

### Two Image Mode

Morphs can be done with one or two images. Single-image morphs are simply reshaped or distorted versions of themselves.

The source and destination are the same image. The more traditional morph uses two images to give the illusion that

## Do Morph

the first image is changing into the second.

Once field lines have been entered on the source and destination images, the actual morphing process can take place.

A single-frame morph is essentially a composite of the source and destination images. For example, a single-frame morph between two people processed at 50 percent would result in a single image that is 50 percent of the first person and 50 percent of the second person.

## Warp Menu

Image warping is a technique used to reshape portions of an image. The effect can also be called a morph, but we classify warps and morphs differently because the techniques (and the underlying mathematical calculations) used to achieve each are different.

Warping is accomplished by moving points on a grid system. The grid can be any size you choose. Each intersection point, where a horizontal and vertical grid line meet, can be moved. This movement in turn distorts the image.

Command	Purpose
Edit Destination Points	Selects the destination image to be the working image so that the destination grid lines can be edited.
Edit Source Points	Selects the source image to be the working image so that the source grid lines can be edited.
Copy Source Grid to Destination	Copying source grids to the destination image will delete any changes to the grids on the destination image. The result will be that both the source image and destination image will have identical grids.
Copy Destination Grid To Source	Replaces the grid lines in the source image with that of the destination image.
Swap Source and Destination Grids	Copies the grid lines of the destination image to the source image and vice versa.
Gridsize	The size of the grid may be adjusted to a small, medium, or large size. The size of the grid can be changed if greater or lesser detail is desired. As the grid size decreases, the degree of detail in the warp increases.
Small	Defines the grid size as small. A small grid size will place a line at every 10 pixels.
Medium	Defines the grid size as medium. A small grid size will place a line at every 25 pixels.
Large	Defines the grid size as large. A small grid size will place a line at every 50 pixels.

Set	Allows the grid size to be manually defined. By entering a value, grid lines will be spaced apart by this number of pixels.
Set Corner	Warping is achieved by dragging intersecting points on the grid. You may find that a point does not exist in the exact location where you would like to affect a change. Use the Grid Corner function to place a grid intersection point.
Set Horizontal	Usually the grids you will use to warp images will be square. However, this does not have to be the case. Use the Set Horizontal and Set Vertical functions to customize the grid. This is done before warping begins to set up points which will allow for more precise control over the warp effect.
Set Vertical	Usually the grids you will use to warp images will be square. However, this does not have to be the case. Use the Set Horizontal and Set Vertical functions to customize the grid. This is done before warping begins to set up points. which will allow for more precise control over the warp effect.
Local Edit Warp	When you drag a grid point, you will see the result immediately upon releasing the mouse. Local warping only affects the sections of the grid immediately adjacent to the grid intersection point moved.
Two Image Mode	Warps can be done with one or two images. Single-image warps are simply reshaped or distorted versions of themselves. The more traditional warps uses two images to give the illusion that the first image is changing into the second.
Do Warp	Performs the warp.

## Help Menu

**Command  
Contents**

**Purpose**

Displays an alphabetical list of all Help topics that are available.

**Search for  
Help on**

Searches for help on a particular topic.

**About...**

Displays HSC Digital MORPH copyright and version information.

To go to any of the following topics, click on its title:



File Menu



Edit Menu



View Menu



Brush Menu



Cutout Menu



Morph Menu



Warp Menu



Help Menu

## Common Questions

Q. Can Video for Windows play .FLC files created in Morph?

A. No, Video for Windows at this point in time does not support any flc or fli file formats.

Q. When Morph is creating the frames for an animation, why do colors in the source and destination windows get distorted?

A. Windows is running in 256 or less color mode. If you are running Windows in 256 color mode, the working window will always take over the color palette. Even if your source and destination have the same palette, the frame you are creating will have a new palette.

During the generation of new images, the source and destination windows will be displayed with the palette of the working window graphic, thus giving them a washed out look. This will not effect the output images in any way, although it is strongly recommended that you run Windows in 32k or higher color modes.

Q. Can I move more than one field point at a time when editing source and destination morph fields?

A. Yes, When editing morph fields, click and hold the right mouse button and then move the mouse to open the rectangular selection area. When you have the area the size that you want, release the button. then, click and hold the right mouse button again to position your selection.

Q. Why do my animation files turn out with washed out colors?

A. Windows is running in 256 or less color mode. If you are running Windows in 256 color mode, it is very important to have a dithering method enabled. If you go to FILE/PREFERENCES/DITHER TYPE, you should find the default set to BURKES dithering.

Having this set to NONE will cause palette problems on machines running 256 colors. Although the Burkes method is a good standard, the other methods are functional and you may want to experiment with them to achieve the best results possible.

Q. How do I get Morph to delete the frames it creates when making animations? How do I get Morph to save the frames it creates when making animations?

A. FILE/EXPORT SEQUENTIAL.  
If you go to FILE/EXPORT SEQUENTIAL you will find DELETE EXPORTED SEQUENTIAL FILES with a box beside it.



An X in the box indicates this function is enabled and Morph will delete all of the frame files after it has finished creating the animation. No X means it is disabled and frame files will not be deleted after Morph has created the animation. Simply click on the box to change its status. After you have set it to the way you would like it, click on OK.

**Q. Can I write a series of frames to an animation file after I create them?**

A. Yes.

You can do this with any series of files, as long as they are named and numbered correctly. For example, SAMPL00.BMP, SAMPL01.BMP, SAMPL02.BMP, SAMPL03.BMP. When you have the series ready, open the first as an image, FILE/OPEN/OPEN IMAGE/SAMPL00.BMP. Now export them, FILE/EXPORT SEQUENTIAL. Note be sure to check the DELETE EXPORTED SEQUENTIAL FILES option. If you are experimenting you should be sure to turn this off so that you don't lose the original frames.

**Q. Why do some of the brushes seem to hesitate when you use them?**

A. Processor speed.

Some of the brushes in Morph, although useful, are very graphically intensive. On slower machines they will hesitate a little when applying them to your image. The faster the machine, the smoother these brushes will operate.

**Q. Why do I have to close my current images to start a new morph?**

A. Morph assumes you want to morph the current image(s). This enables you to start fresh without having to reopen the images you are working on. To start with new images, you must close the current ones.

**Q. Is a math co\_processor required for Digital Morph?**

A. No. But a co\_processor will help the overall performance of morph on machines not equipped with one.

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