Fax - Facial Animation System.

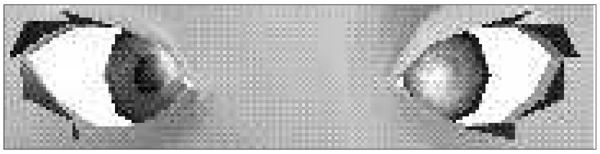
The following details the various parts of **fax** - a facial animation system which allows for spline based keyframe interpolation. It uses the data from Frederic Parke's facial system and Mark Overmars Forms library. This system would not be possible without these two sources.

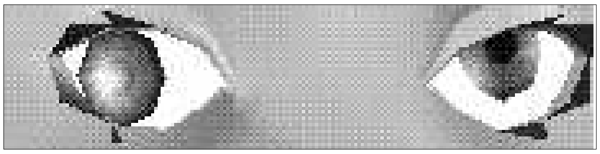
The interface is divided up into 4 regions:

The face proper:

Left, Right and Middle mouse buttons affect the head rotation, head distance and the direction the eyes look.

Individual control of each eye is available only via the unganged parameter box.



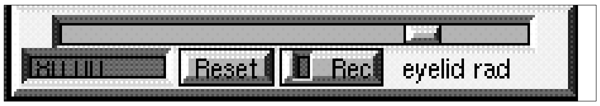


The parameter boxes:

Each box has

- a horizontal slider to control the parameter between a minimum and maximum bound. Slider changes echo into the input field below.
- an input, editable field to exactly specify the parameter within the bounds. The field may be cleared via ESCAPE or edited via positioning with the mouse and then BACKSPACING or inserting. Input changes are reflected in the slider.
- a reset button to reset the parameter to its original value. The slider and input field are updated accordingly.
- a record button to enable recording of this parameter as an animated piece is developed. Manipulating a value when the rec light is off will result in a warning unless all recording is turned off (see parameter control box section below).
- a label describing what the parameter controls.

The left and right hand sides of the face can be independantly controlled (see below).



The control boxes:

EXIT
: Does the obvious thing but asks if you ruly truly mean it.

WIRE
: Toggles between wire frame mode and full shaded mode for displaying the face. For non 24 bit plane systems, the shaded image is fearful.

HELP
: A movable scrollable help window which is this text.

Reset all
: Resets ALL parameters to their default values. Updates all sliders, input fields and min and max bounds.

->FACES
: Allows the user to save the current state of the parameters as ascii text. This can be modified via your favourite editor. Default extension is ".prm", default directory is "./prm".

<-FACES
: Reads in a parameter file saved as above. Note that parameters with no description are not setup. Default extension is ".prm", default directory is "./prm".

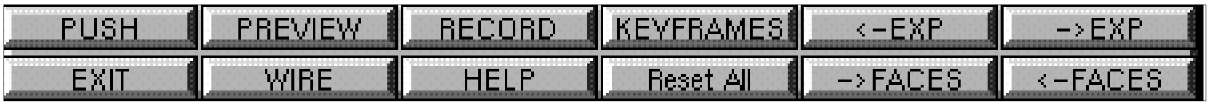
PUSH
: Pushes fascia to the back of all other windows. (See POP below).

PREVIEW
: Will play the entire animation. The button changes to "STOP". On an entry level indigo, the animation is capable of real time wireframe playback. The time taken to preview it, is shown in the timer beneath the EXIT button.

RECORD
: Brings up the "RECORD" Interface (see below).

KEYFRAMES
: Brings up the "KEYFRAMES" Interface (see below).

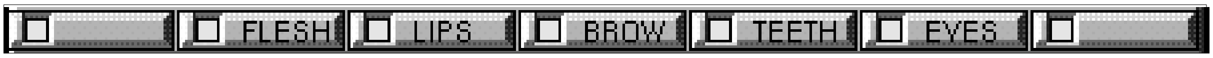
POP
: Pops fascia to the front of the screen again. Note the position of these TWO buttons at the sides of the fascia system.



The visibility control boxes:

FLESH LIPS BROW TEETH EYES

Toggles visibility of the named facial areas on off. The light means that the object should be visible.



The parameter control boxes:

The left and right hand sides of the face can be independantly controlled.

RIGHT1

There are now too many parameter boxes for the right hand side of the face - this will replace the column of parameter boxes with another set. Both sets of boxes (identical for the left and right hand side) can be seen on the following page.

GANG

When active (light is on), this will cause changes in the parameters for one side of the face to be reflected in the other side. When off, independant control of either side is possible.

BOT1

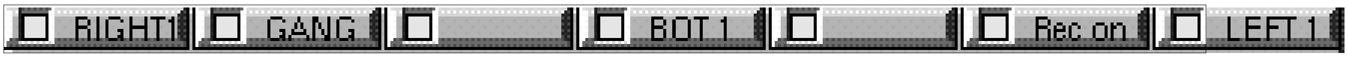
There are now too many parameter boxes for the overall control of the face - this will replace the bottom section of parameter boxes with another set. Both sections of boxes can be seen two pages on.

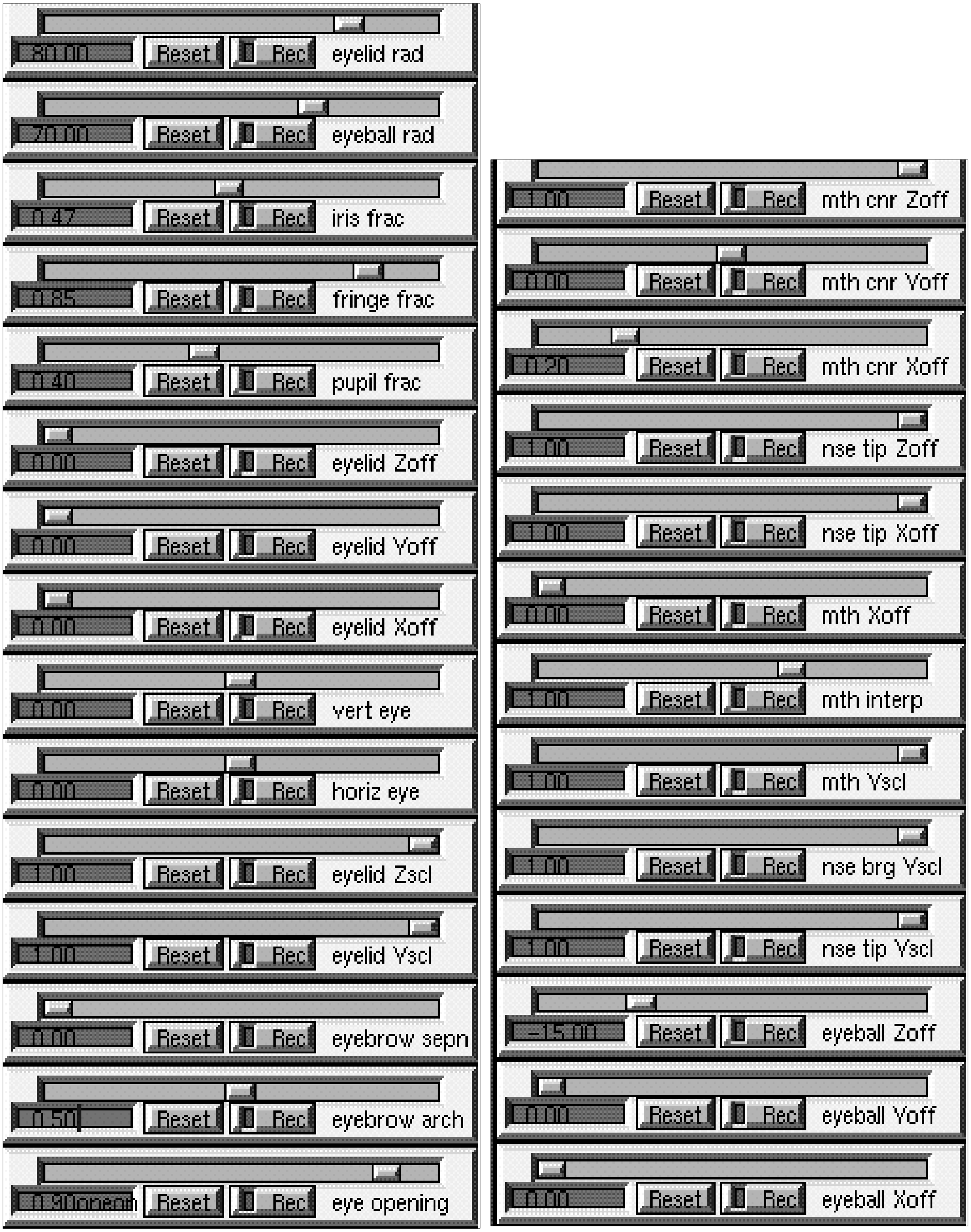
Rec on

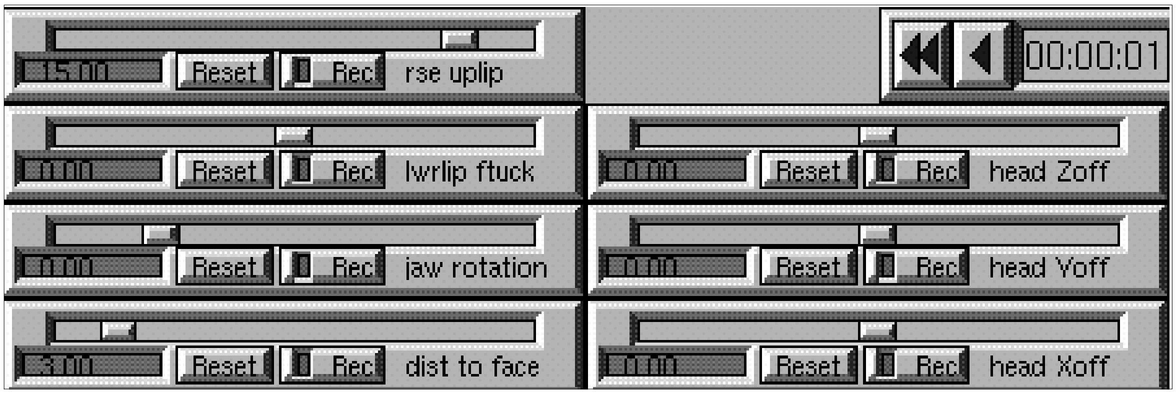
This enables the recording of parameters for an animated piece. If this button is lit, then the manipulation of a parameter which has not been individually enabled for recording will cause a warning dialog to appear. This is a safeguard which prevents a lot of work going down the drain, when you belatedly notice that the last 2 hours of meticulous complex parameter adjustments have not been recorded because one of the parameters was not enabled for recording.

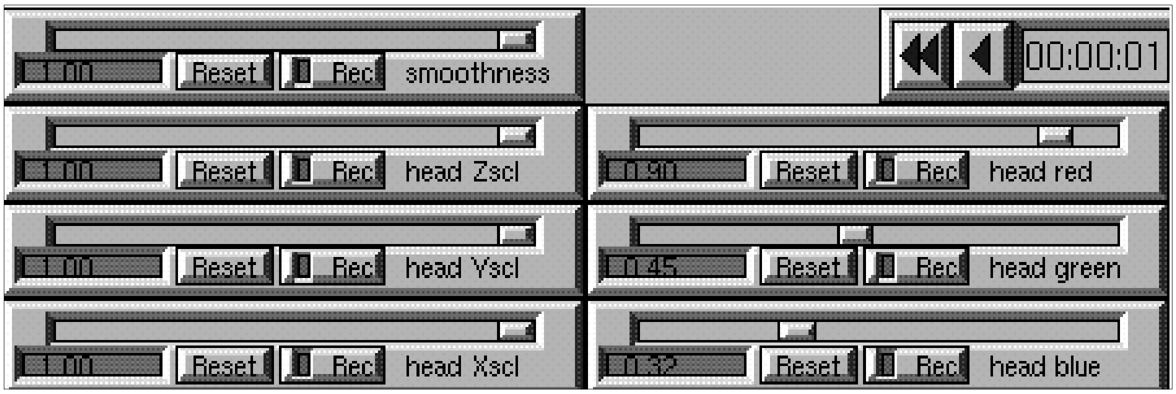
LEFT1

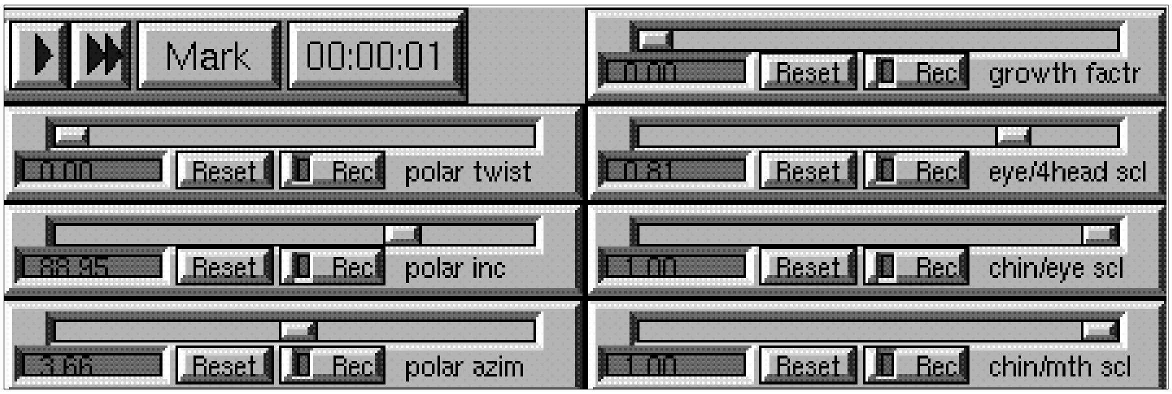
As above for the right side of the face.

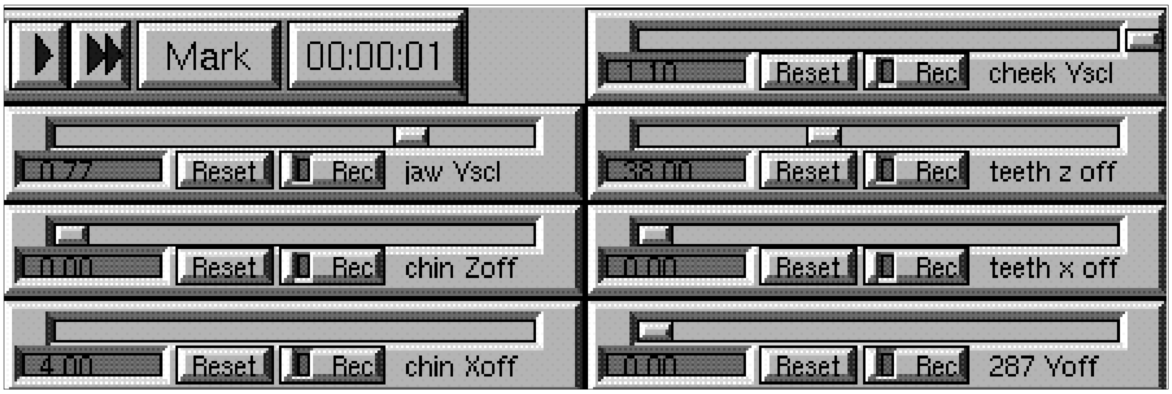



80.00 Reset Rec eyelid rad
70.00 Reset Rec eyeball rad
0.47 Reset Rec iris frac
0.85 Reset Rec fringe frac
0.40 Reset Rec pupil frac
0.00 Reset Rec eyelid Zoff
0.00 Reset Rec eyelid Yoff
0.00 Reset Rec eyelid Xoff
0.00 Reset Rec vert eye
0.00 Reset Rec horiz eye
1.00 Reset Rec eyelid Zscl
1.00 Reset Rec eyelid Yscl
0.00 Reset Rec eyebrow sepn
0.50 Reset Rec eyebrow arch
0.90 Reset Rec eye opening
1.00 Reset Rec mth cnr Zoff
0.00 Reset Rec mth cnr Yoff
0.20 Reset Rec mth cnr Xoff
1.00 Reset Rec nse tip Zoff
1.00 Reset Rec nse tip Xoff
0.00 Reset Rec mth Xoff
1.00 Reset Rec mth interp
1.00 Reset Rec mth Yscl
1.00 Reset Rec nse brg Yscl
1.00 Reset Rec nse tip Yscl
-15.00 Reset Rec eyeball Zoff
0.00 Reset Rec eyeball Yoff
0.00 Reset Rec eyeball Xoff


00:00:01
15.00
Reset
Rec
rse uplip
0.00
lwrlip ftuck
0.00
jaw rotation
3.00
dist to face
0.00
head Zoff
0.00
head Yoff
0.00
head Xoff


00:00:01
1.00
Reset
Rec
smoothness
1.00
head Zscl
1.00
head Yscl
1.00
head Xscl
0.90
head red
0.45
head green
0.32
head blue


Mark
00:00:01
0.00
Reset
Rec
polar twist
88.95
polar inc
3.66
polar azim
0.00
growth factr
0.81
eye/4head scl
1.00
chin/eye scl
1.00
chin/mth scl


Mark
00:00:01
0.77
Reset
Rec
jaw Yscl
0.00
chin Zoff
4.00
chin Xoff
1.10
cheek Yscl
38.00
teeth z off
0.00
teeth x off
0.00
287 Yoff

The keyframe marking controls

This interface is used to mark keyframes whilst constructing an animated piece. The interface is divided into two regions - the time elapse indicator and the keyframe marker proper.

Time elapsed indicator

This is used to see whether the "PREVIEW"ed animation takes the correct amount of time or not. **fax** can display realtime wire frame preview on an entry level Indigo. The value printed is in minutes:seconds:frames and is as accurate as the *times* system routine.

Keyframe marker

The keyframe marker is used to set various keyframe positions in an animated piece. It consists of:

Arrow buttons

Used to change the value of the keyframe time by seconds or frames in either direction. If you move forwards in time, without having set an initial keyframe, it is assumed that you want to move forwards in time re a known keyframe file. You are prompted for the name of the keyframe file to load.

Frame counter

A minutes:seconds:frames counter which tells you the current keyframe.

Mark button

When pressed, this button will set a keyframe position for all parameters that are currently recording.
Make certain the "Rec on" light is lit - this will give you warning if you attempt to change a parameter without it being individually record enabled.

If no parameters are enabled then you are warned of this.

If you change a parameter and it is not being recorded, then you are warned of this.

If you set the first parameter and then advance the frame counter via the arrow buttons, **fax** tries to interpolate to that point via its keyframe splining system. Obviously, the first time it tries to interpolate, there will be too few keyframes and hence this message is printed on standard error.

too many/few points to interpolate

It is not an error - just the result of trying to help you.

If the keyframe already exists, then you are informed that you are adding to it. This is not an error, simply information to keep you on the straight and narrow.

If the parameter values that you add to this keyframe are different from those that are already present, then for each different parameter its name,number old value and new value are displayed in a question dialog and you are asked whether you wish to overwrite the old value or leave it as it is. This can happen if you forget to turn off the recording light of a few parameters when starting a new lot of keyframe values (i.e. set keyframes for gross head movements first, then eyes, then mouth, etc).

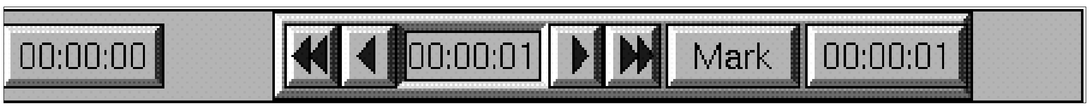
Note that the order in which to set a keyframe is important. If you set the parameter value and then move to the keyframe, then the spline interpolation will adjust all parameters to fit smoothly along the curve. This will change your values!!

Therefore

(i) Move to the appropriate keyframe and THEN
(ii) Set the parameter values THEN
(iii) Press the MARK button.

Synchronise label

This is a synchronous time indicator which can be set with an offset via the -o <framenumber> parameter to fax. It is used to synchronise the keyframes with some pre-recorded video, etc with an existing time-code.



Note that if you exit from **fax** and you have modified the keyframes then you are prompted for the name of a save file. This may be cancelled.

Record Interface

This interface will pop up when the "RECORD" button is pressed. The interface consists of a number of menus, buttons, fields and sliders.

RECORD

The "RECORD" button will start the recording of frames from the screen (given the settings described below). The frames are stored in a subdirectory called "frames" of the current directory. This directory will be created if needed. Each frame will have a name on disk starting with the letter f followed by the frame number. That is, the first frame is f1, the second f2, the thirtieth f30, etc. These frames are in Silicon Graphics format (eg *ipaste*, *istat*,etc). The frame can be of PAL size, PAL/2, PAL/4, NTSC, NTSC/2, NTSC/4 and the normal small screen size. It may be full colour or wireframe. It may have a single frame as a background in colour mode. It may also have the frame number at the bottom of the image. **Dont forget to turn off a screen saver if it changes the graphics image on the screen i.e exploding volcanoes or submarine-eating fish....**

frames

This will toggle the displaying of the frame number underneath the face display.

WIRE

This will toggle the display between wire and colour format for the recording.

HIDE

This will cause the Record Interface to go away.

Screen

This is a Right Mouse button menu which lets the user set the recording format. The values available are:

Screen, PAL, PAL/2, PAL/4, NTSC, NTSC/2, NTSC/4

Background image

This puts up a file selection box so that a user can choose a colour backdrop for the animation. Each frame will have this image displayed before the face is drawn and saved to file. This is obviously handy but can be grossly inefficient in terms of disk space (we don't care as we temporally compress our files so only the differences are stored). It is better to do this compositing on the raw file than this way IF you have the abilities (see SGI program *over*).

QUIT

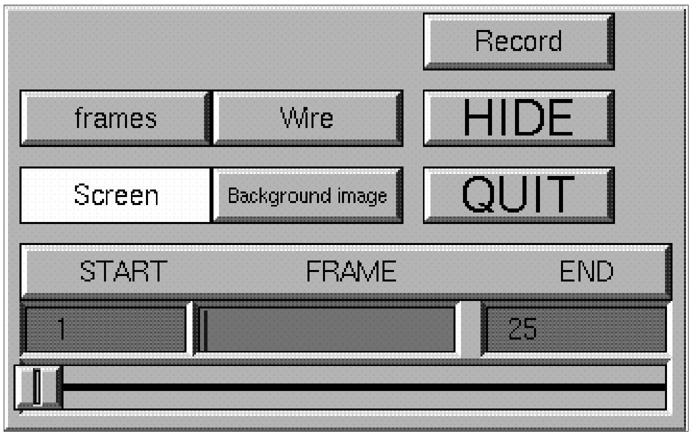
This will cause fax to go away with a confirmation.

START FRAME END and Fields

A label for the start, current and end frame fields underneath. These fields can be edited to specify the starting and ending frames to record. The current frame field can be edited : the entered frame value will be displayed on the screen. You may use a frame number or min:sec:frame notation.

SLIDER

This lets the user choose a frame from within the START-END limits. The frame will be displayed. This can be used to work out which starting frame to use BUT it does not update the START time.



Keyframe Interface

The Keyframe interface is used to fiddle with aspects of the keyframe system. It consists of a number of buttons,fields and a slider:

Save keyframes

This button will pop up a file selection box which lets the user save the keyframes in a file. The extension is ".kyf" and the subdirectory "./kyf" is used for the file storage. The format of the stored file is

```
<Facial initial parameters>

<Keyframe number>
<parameter_number value description>
<parameter_number value description>

<Keyframe number>
<parameter_number value description>
<parameter_number value description>

                 :
```

For example:

```
       0 0.000000 0.000000 1.000000 0.000000 1 0
       0 0.000000 0.000000 1.000000 0.000000 1 0
       1 0.900000 0.000000 1.000000 0.900000 1 1 eye opening
       1 0.900000 0.000000 1.000000 0.900000 1 1 eye opening
                      :
       61 0.450000 0.000000 1.000000 0.450000 1 1 head green
       61 0.450000 0.000000 1.000000 0.450000 1 1 head green
       62 0.320000 0.000000 1.000000 0.320000 1 1 head blue
       62 0.320000 0.000000 1.000000 0.320000 1 1 head blue

    1.000                               ;00:00:01 keyframe value
  4    0.000 left  jaw rotation         ;
 -4    0.000 right jaw rotation         ;
 13    1.000 left  mth interp           ;
-13    1.000 right mth interp           ;

    7.000                               ;00:00:07 keyframe value
 55    0.000 left  horiz eye            ;
-55    0.000 right horiz eye            ;
 56    0.000 left  vert eye             ;
-56    0.000 right vert eye             ;

             :
  250.000                               ;00:10:00 keyframe value
 52    3.656 left  polar azim           ;
-52    3.656 right polar azim           ;
 53   88.945 left  polar inc            ;
-53   88.945 right polar inc            ;
  3    0.000 left  eyebrow sepn         ;
 -3    0.000 right eyebrow sepn         ;
  4    5.236 left  jaw rotation         ;
 -4    5.236 right jaw rotation         ;
 13    1.412 left  mth interp           ;
-13    1.412 right mth interp           ;
```

Load keyframes

This button will pop up a file selection box which lets the user load keyframes from a file. The extension is ".kyf" and the subdirectory "./kyf" is used for the file retrieval.

Dump Splines

All of the keyframe parameters are dumped into the subdirectory "./splines". These files can be looked at via the *displine* program (See appendix for information on displine).

PREVIEW

Will play the entire animation. The button changes to "STOP". On an entry level Indigo, the animation is capable of real time wireframe playback.

HIDE

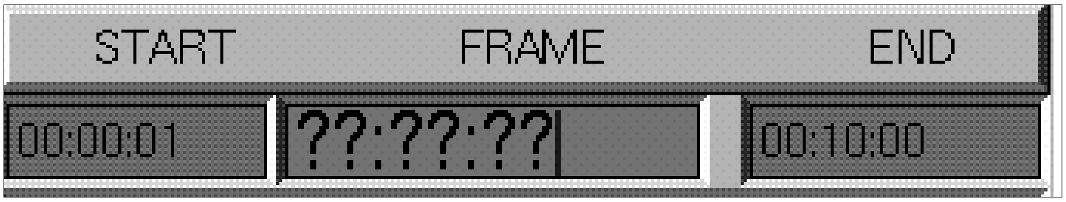
This will cause the Record Interface to go away.

Browse

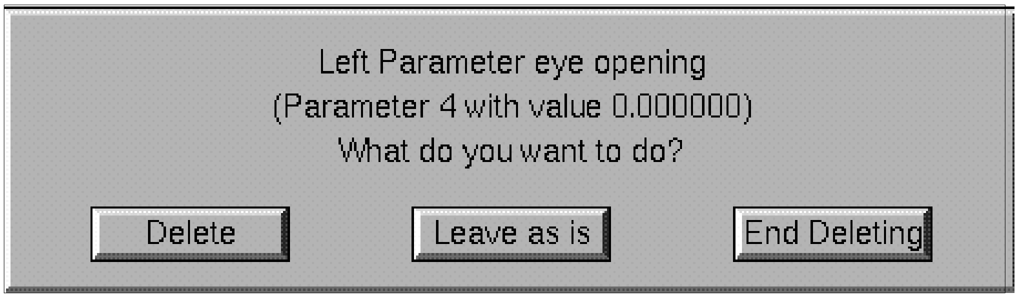
This will let the user browse through a file on disk - it is typically used to look at a keyframe file but can look at any text file.

Delete

This button will enable a user to delete a parameter value at a keyframe. When pressed, the current frame label will change to:



The user should then type in the frame number to use for deleting the parameters. If no keyframe exists at that frame then the user is informed otherwise for every parameter set for that keyframe the use is shown :



The user may opt for one of the options with obvious results.

Delete all

This allows a user to delete **all** parameters from a keyframe. A dialog box asks the user if he/she is ruly truly intent on deleting and if so, then does it.

QUIT

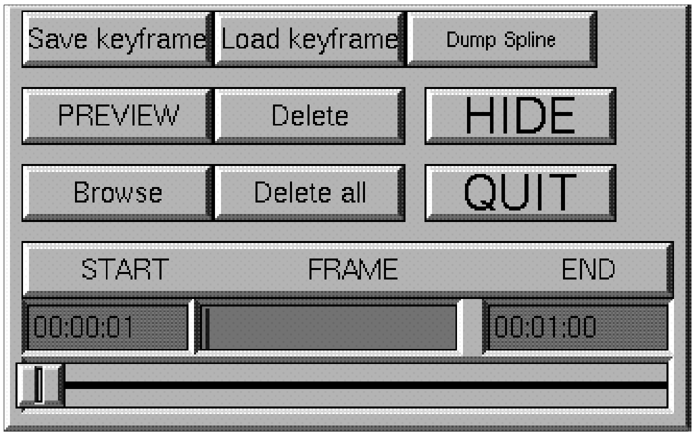
This will cause fax to go away with a confirmation.

START FRAME END and Fields

A label for the start, current and end frame fields underneath. These fields can be edited to specify the starting and ending frames to preview. The current frame field can be edited : the entered frame value will be displayed on the screen. You may use a frame number or min:sec:frame notation.

SLIDER

This lets the user choose a frame from within the START-END limits. The frame will be displayed.



General facts

Fax reads 5 files:

File	Used for
fascia.st1:	point data.
fascia.st2:	interpolated point data for vertex movement.
fascia.top:	for the topology of the points.
fax.hlp:	this file.
prm/default.prm:	the default parameter file.

If these files are not found in the users area, then the default system area is examined.

The data sections of the point and topology files may be commented by lines starting with #.

The following directories are important to fax:

Directory	Used for
bg:	Background sgi format images
exp:	Saving and retrieving expressions
frames:	Storing animation (could be linked to a spare gigabyte of disk)
kyf:	Storing keyframe animation files
prm:	Storing parameter files
splines:	Storing the spline value files

Command Line Options

fax is typically called with a filename which specifies the keyframe animation. This file is normally stored in the "./kyf" directory with extension ".kyf". **fax** takes a number of optional arguments:

fax [-s] [-e x,y,z] [-o offset_time] [-v] [-n] [-W]
[-P] [-pfilename] [-w] [-f] [-F] [-d] [-D] [file.kyf]

These arguments provide the following functionality:

-s
: Use smooth ride in splines.

-e x,y,z
: x,y,z specify the eye offset. This useful if you have a face model without eyes since **fax** generates its own eyes.

-o offset_time
: Offset time is for synchronisation. If you are lip synching, then you will probably have a previously recorded time-coded video. This will specify the offset from frame 1 to this point on the video. The value specified, as a frame number, will be shown in the Mark Interface Box.

-v
: Screen size is PAL and go into video mode. Used in conjunction with the -P switch to start **fax** recording the animation.

-n
: Screen size is NTSC and go into video mode. Used in conjunction with the -P switch to start **fax** recording the animation.

-W
: Screen size is normal and go into video mode. Used in conjunction with the -P switch to start **fax** recording the animation.

-P
: Record the frames now. **fax** will start up and go into record mode saving the frames as mentioned above. This is normally accompanied by the -v or -n switch.

-p
: Specify the file name for data. Useful if you have a different set of data which conforms to the **fascia** specification.

-w
: Use wire frame.

-f

Window is in foreground. Good for debugging the bugger - used to work, then Marc Overmars changed where he put the winopen!! (We still love him though :?))

-F

No forms support - menu only. A very old un-supported form of fax which is no longer used.

-d

No displaying - check only. The files are checked but neither form nor face are shown.

-D

Debug info printed out. At present this information is fairly minimal.

Notes

(1) The number of frames per second can be set by changing the value of the FRAMES_PER_SECOND constant in "timing.h". Default value is:
#define FRAMES_PER_SECOND 25

(2) The number of bit planes available for proper double buffering of coloured images can be set via the OK_FOR_DOUBLE_BUFFERING constant in "doublebuffering.h". If the machine has this many or more then double buffering will occur on all manipulations of the shaded image. This is useful in that an entry level Indigo will use single buffering for the fixed image but resort to double buffering (with loss of image quality when the image is manipulated via the mouse. Default value is:
#define OK_FOR_DOUBLE_BUFFERING 4

(3) The number of segments used to create the eyes is defined via the SEGMENTS constant in "eye_segments.h". It is used to create the bands that make up each eye. The number affects the quality as well as the speed of the display. Default value is:
#define SEGMENTS 8

(4) **fax** searches for the default files in your area first and then in the DEAFULT_DIR directory defined in the file "default_dir.h". The default value is:
#define DEFAULT_DIR "/usr/local/lib/fascia"